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Rehm: Ascomycetes exs. Fasc. 51.

Durch die fortdauernden Einsendungen bewährter mykologischer Forscher ist die Fortsetzung der Sammlung ermöglicht, welche auch fernerhin eine Stütze für wissenschaftliche Forschung bleiben möge! Den Mitarbeitern, bes. Herrn Professor Dearness, dann den Herren Jaap, Petrak, Strasser, Ade, Professor R. Maire, Kirschstein, Staritz gilt mein bester Dank.

Neufriedenheim/München XII, 1. November 1912. Dr. H. Rehm.

2001. **Helvella elastica** Bull.

Cfr. Rehm Discom. p. 1184.

Auf Sandboden bei Spalt in Mittelfranken, leg. Beckenbauer.

(Die vorliegenden, zu gleicher Zeit am gleichen Ort gesammelten Exemplare zeigen verschiedene Übergänge zu var. *albipes* Fuckel und zu *Helvella monachella* Fr. Charakteristisch ist der im frischen Zustand schneeweiße, glatte Stiel mit gleicher Farbe der Unterseite des Hutes, dessen äußere Farbe je nach den örtlichen Wachstumsbedingungen von fleischfarbig-dunkelbraun wechselt. Der Stiel ist zuerst zylindrisch, 3—4 mm breit, wird später buchtig — mehr als 1,5 cm breit wie bei *monachella*. Es fanden sich Exemplare mit 4—10 cm langem, unten 0,5—1,5 cm, oben —2 cm breitem Stiel, der Hut 3—6 cm breit, —2,5 cm hoch.)

2002. **Urnula Craterium** Fr.

Syn.: *Geopyxis Craterium* (Fr.) Rehm Discom. p. 974.

Cfr. Seaver: Jowa Discom. p. 119, tab. 39 fig. 2.

Exs.: Rabenh. Winter f. eur. 2968, Ravenel f. am. 633, Ellis N. am. f. 982.

On decaying oak branches laying in leaf mold in woods. London, East shore of Lake Huron, Ont. Canada, 3. 1912. Dearness.

2003. **Lamprospora dictydiola** Boud. (Disc. d'Europe p. 68).

Hériménil, bois du Fréhaut (Meurthe et Moselle) parmi les Funaria, near une place à few, 3. 1907, Prof. Dr. R. Maire.

(Dr. Maire sandte den Pilz mit obiger Benennung. Der Pilz gehört mit seinen kuglig runden Sporen zur Gattung: *Detonia* Sacc. und besitzt nach Boudier zart retikulierte Sporen. An den vielen untersuchten Exem-

plaren fand ich auch vereinzelt solche, zumeist aber ganz glatte Sporen mit 1 großen zentralen Öltropfen. Nach diesen läßt sich der Pilz von *Detonia carbonaria* (Fuckel) cfr. Rehm Disc. p. 931, ebenfalls auf Brandstellen, soweit diese bekannt ist, kaum trennen. Allerdings stellt Boudier l. c. p. 70 die Fuckel'sche Art unter seine Gattung *Pulvinula* mit „réceptacles non cupulaires", während er als Parallele zu *dictydiola* mit zart netzförmigen Sporen die *Lamprospora carbonicola* Boud. mit glatten solchen bringt.)

2004. **Belonium pruinosum** (Jord.) v. Höhnel (Fragm. myc. VI p. 100).

Syn.: *Belonidium pruinosum* Rehm (Disc. 5076, Nachtr. p. 1264).

Exs.: Krieger f. sax. 1034, Cooke f. brit. I 575, II 390, Phill. Elv. brit. 89, Jaap f. sel. 309, Rabh. f. eur. 1514, Thümen Myc. un. 1210.

Parasitisch auf Diatrype Stigma an *Fagus*-Ästen. Sachsenwald bei Hamburg. Jaap.

2005. **Pezizella inquilina** (Karst.) Rehm (Disc. p. 675).

An dürren Halmen von *Equisetum sylvaticum*. Wohldorf bei Hamburg. Jaap.

2006. **Mollisia Rabenhorstii** (Awd.) Rehm (Disc. p. 537).

An faulenden Blättern von *Quercus lanuginosa* bei Abbazia/Istrien, 4. 1912. Jaap.

2007. **Coryne sarcoides** (Jacq.) Tul. *vera!*

Cfr. Rehm Discom. p. 489.

Exs.: Phillips Elv. brit. 138, Cooke f. brit. II 482.

An Buchen. Großkühnau/Anhalt, leg. Staritz.

2008. **Phacidium Vincae** Fuckel.

Cfr. Rehm Disc. 4504, Ber. bayr. bot. Ges. XIII p. 123.

Exs.: Fuckel f. rhen. 1029, Rabenh. f. eur. 1642.

An dürren Stengeln und Blättern von *Vinca minor* bei Weismain/Oberfranken, mit *Cytispora foliicola* Libert. Ade.

2009. **Tryblidium calyciforme** Rebent.

Cfr. Rehm Disc. p. 196, Ber. bayr. bot. Ges. XIII p. 138.

Exs.: Cooke f. brit. II 462, Karsten f. fenn. 336, Fuckel f. rhen. 1001, Rabenh. f. eur. 231.

An der Rinde alter Eichen im Spessart bei Lohr a/Main. Rehm.

2010. **Hysterographium biforme** Sacc. (Syll. II p. 773).

Cfr. Rehm: Ber. bayr. bot. Ges. XIII p. 107.

In hohlen alten Eichen. Svrčov bei Mährisch-Weißkirchen/Mähren, 3. 1912, leg. Petrak.

2011. **Gloniella filicina** (Lib.) Mouton var. **Jaapii** Rehm.

Cfr. Ber. bayr. bot. Ges. XIII p. 114.

Auf *Aspidium spinulosum*. Triglitz in der Priegnitz. Jaap.

2012. **Hypomyces cervinus** (Ditmar) Tul. (Carp. III p. 51).

Cfr. Winter Pyr. p. 137 (Conidien), Sacc. Syll. II p. 477, Schröter Schles. p. 268 (Conidien), Ell. et Ev. N. Am. Pyr. p. 77 (sub Mycogone).

Auf *Helvella elastica* und *Ephippium*. Tempelhofer Park bei Berlin auf lehmigem Boden im Gebüsch, 7. 1891, leg. Hennings.

Schläuche einzeln an farblosen, —6 μ breiten, selten etwas verästelten Hyphen, eiförmig-elliptisch, zart, 27—30 ⩽ 15—17 μ, 4-sporig. Sporen zylindrisch, an beiden Enden abgerundet, gerade, in der Mitte quer geteilt, in jeder Zelle ein kleiner Öltropfen, farblos, 15—18 ⩽ 4,5—5 μ. Chlamydosporen rund, grobwarzig, gelb, 15 μ breit.

2013. **Lasiosphaeria canescens** (Pers.) Karst. (Myc. fenn. II p. 161).

Syn.: *Leptospora strigosa* (Alb. et Schw.) Fuckel.

Exs.: Fuckel f. rhen. 948, Cooke f. brit. I 590, Plowr. Sphaer. brit. I 65.

An faulem Nadelholz auf dem Sonntagberg/N.Österreich. Strasser O. S. B.

Die Exemplare sind alt, meist ohne Fruchtschicht! Die Beschreibung von Alb. et Schw. (Consp. f. p. 37) sub Sphaeria canescens ββ *nigra*: „sphaerulae nigrae, nunquam canae, mira abundantia conspicuae, qua truncos abietinos, vix alios semiputres, saepe totos quantos cohortibus arcte stipatis obvestiunt", stimmt trefflich zu diesen Exemplaren, dagegen *strigosa* Alb. et Schw. tab. V, f. 7: „apotheciis barba incana rigida undique obsessis, ostiolo papillato-subobsoleto" zu obigen Exs.

(Winter (Pyren. p. 316), Berlese (Ic. f. I p. 109 tab. 107 f. 2, f. 3), Karsten l. c. geben die Sporen 26—40 ⩽ 5—7 μ an. Ich kann sie in diesen Exemplaren nur 18—20 ⩽ 4—5 μ finden und Ell. et Ev. N. Am. Pyr. p. 148 beschreiben sie: „20—30 ⩽ 4—5 μ with 2 large nuclei at first, finally 1 septate, hyaline, becoming brownish", dazu stimmt meine Untersuchung. Weiter betrifft den Pilz: Seaver (Mycol. IV p. 118 pl. 166 f. 4—7), Kirschstein: Pilze Brandenburgs p. 208.)

2014. **Melanomma pulvis pyrius** (Pers.) Fuckel f. **dispersa** Rehm.

An einer sonnigen Hiebstelle einer Buche oberhalb dem Eibsee in den bayr. Alpen, Dr. Rehm.

(Macht zuerst einen besonderen Eindruck mit ganz zerstreuten Perithecien, die aber sich allmählich in die gedrängte Form verfolgen lassen und in ihrer ganzen Beschaffenheit zur Art gehören.)

2015. **Mycosphaerella innumerella** (Karst.) Schröter (Schles. Cr. III 2 p. 337).

Cfr. Sacc. Syll. I p. 506, Winter Pyr. p. 370.

Exs.: Rabenh. f. eur. 1042, Krieger f. sax. 1773, Plowr. Sphaer. brit. III 98.

An dürren Blättern von *Comarum palustre*. Steckelsdorfer See bei Rathenow a/H. Kirschstein.

2016. **Guignardia Adeana** Rehm n. sp.

Perithecia subgregaria, plerumque paginae superiori folii late flavidulae innata eamque protuberantia, globulosa, papillula minutissima prorumpentia, membranacee contexta, glabra, 0,3 mm lata. Asci cylindraceo-

subfusiformes, haud stipitati, apice rotundati, 130—140 ⩾ 25 µ, 8-spori. Sporae oblongae, utrinque obtusae, 1-cellulares, hyalinae, demum dilutissime flavescentes, 20—24 ⩾ 9—11 µ, strato mucoso tenui obductae, 1—2-stichae. Paraphyses nullae.

In foliis *Polygalae Chamaebuxi*. Wiesenfels im fränkischen Jura, 8. 1909, leg. Ade.

(Steht in nächster Verwandtschaft mit *Laestadia Rhododendri* (DN.) Sacc. Syll. I p. 428.)

2017. **Venturia Cassandrae** Peck.

Cfr. Sacc. Syll. IX p. 689, Ell. et Ev. N. Am. Pyr. p. 140.

Exs.: Ell. et Ev. N. am. f. 2363.

On living leaves of *Cassandra calyculata*. London/Ont. Canada. Dearness.

(Der Pilz ist reichlich auf der Unterfläche der Blätter vorhanden, aber äußerst schwierig sichtbar und zeigt nicht die im Exs. Ellis deutlich vorhandenen Borsten.)

2018. **Quaternaria quaternata** (Pers.) Schröter (Schles. Cr. III 2 p. 451).

Cfr. Sacc. Syll. I p. 106, Winter Pyr. p. 824, Berlese Ic. f. III p. 33 tab. 41, Traverso fl. it. cr. p. 78, Ellis et Ev. N. am. Pyr. p. 480 p. p.

Exs.: Moug. et Nestl. St. vog. 179, Bad. Crypt. 136, 334, Rabh. f. eur. 148, 255, 815, 1247, Sydow Myc. march. 260, Krieger f. sax. 839, Allescher & Schnabl f. bav. 255, Fuckel f. rhen. 621, Thümen f. austr. 182, Myc. un. 465, Plowright Sphaer. brit. I 49, Cooke f. brit. II 221.

An *Fagus*-Ästen bei Mährisch-Weißkirchen/Mähren, leg. Petrak.

2019. **Pleosphaerulina corticola** (Fuckel) Rehm.

An Ästen von *Rosa canina*. Welka bei Mährisch-Weißkirchen/Mähren, leg. Petrak.

Starbäck (Bot. Not. 1890 p. 117) hat auf Grund des Originalexemplares von Fries folgendes festgestellt:

Sphaeria sepincola Fr. (Obs. myc. I p. 181) in caulibus Rosarum.

Syn.: *Metasphaeria sepincola* Sacc. Syll. II p. 164 p. p.
Leptosphaeria sepincola Winter Pyr. p. 473 p. p.
Sphaerulina sepincola Winter Pyr. p. 404.

Dazu gehört:

Sphaeria intermixta B. et Br. (Br. f. 639).

Sphaerulina intermixta Sacc. Syll. II p. 187, f. it. del. 347.

Pleosphaerulina intermixta Berl. (Ic. f. I p. 124 tab. 131 f. 1 sub Sphaerulina) Ic. f. II p. 98.

Zur Klärung dieser auf *Rosa, Rubus, Cornus* weit verbreiteten, aber so vielfältig verwechselten und nur durch mikroskopische Untersuchung sicher unterscheidbaren Art muß die Beschreibung Winter's p. 404, mit welcher Schröter (Schles. Cr. p. 344) übereinstimmt, hier angeführt werden:

„Schläuche büschelig rosettenförmig verbunden, oblong-keulenförmig, anfangs am Scheitel stark verdickt, 40—55 ⩾ 12—15 µ. Sporen keulig

oder oblong spindelförmig, nach unten stärker verjüngt als oben, mit 3—5 Querwänden und Längsteilung einzelner Zellen, farblos, 16—18 ≫ 5—6 µ." Paraphysen werden nicht angeführt.

Mit dieser Beschreibung stimmt genau überein das schöne Bild von Berlese l. c. I tab. 121 f. 1, ferner Exs. Fuckel f. rhen. 2242 (sub Sphaeria glomerulata Fckl.) an Rubus und Krieger f. sax. 1069 auf Rosa, endlich Rehm Ascom. 98 (sub Stigmatea seriata Winter) auf Rosa.

Charakteristisch für *sepincola* mit den angeführten Syn. ist die Anordnung der keuligen, dickwandigen Schläuche und der völlige Mangel von Paraphysen.

Unterschieden davon muß werden:

Pleosphaerulina corticola (Fuckel Symb. myc. p. 114 tab. III f. 14 sub Sphaeria).

Syn.: *Metasphaeria corticola* Sacc. (Syll. II p. 166).

Leptosphaeria sepincola Winter Pyr. p. 473 p. p. „eine sehr unsichere species".

Leptosphaeria lejostega (Ellis Exs. sub Sphaeria) Eliasson.

Metasphaeria lejostega Sacc. (Syll. II p. 164).

Dazu gehört: Exs. Ellis N. am. f. 888, Rehm Ascom. 1189 auf Rubus.

Cfr. E. et Ev. N. Am. Pyr. p. 383 („lejostega is certainly near of Metasphaeria corticola (Fckl.)"), ferner Rehm (Hedwigia XXXV p. 149).

Für diese weitverbreitete, bes. auch *Prunus*, *Crataegus* bewohnende Art ist charakteristisch:

Schläuche zylindrisch, fast sitzend, —150 ≫ 8—10 µ. Sporen 1-reihig, länglich, später keulig und in der Mitte etwas eingeschnürt, zuerst quer 3-, später 7-fach geteilt, und im Alter mit einzelnen längsgeteilten Zellen, 15—20 ≫ 5—7 µ, farblos, Paraphysen meist fehlend. Jod färbt oft den Porus innen blau.

Der Unterschied von *sepincola* besteht also in zylindrischen Schläuchen mit 1-reihig gelagerten Sporen.

Zu dieser Beschreibung stimmt *sepincola* bei Schröter l. c. p. 383, ferner ein mir aus Herb. Barb. Boiß. zugegangenes Originalexemplar Fuckels no. 385 sub *Metasphaeria sepincola* (Fckl.) Fckl. Symb. Nachtr. II p. 22 nec p. 114, auf *Rosa canina* bei Oestrich a/Rh. Auf *Crataegus*-Ästen kommt dieser Pilz häufig vor, Exs. Jaap f. sel. 424, und zeigt sich oft in sehr vorgeschrittener Größe und Teilung der Sporen.

Offenbar verschieden davon ist *Metasphaeria sepincola* bei Berlese Ic. f. I p. 132 tab. 142 f. 2, welche im Bild keulige Schläuche mit 2-reihigen, nur 4-zelligen, spindelförmigen Sporen gibt und eine Mehrzahl von Arten umfassen wird. Berlese Ic. f. II p. 100 hat die Gattung *Catharinia* Sacc. (Syll. XI p. 350), zuerst von Sacc. Syll. II p. 275 als Untergattung von *Pleospora* mit farblosen Sporen angenommen, genau begrenzt wie es im vorstehenden *Metasphaeria corticola* ist und im vollen Gegensatz zu *Pleosphaerulina sepincola* „asci cylindracei vel clavati, nunquam saccati", aber

„paraphysibus filiformibus distinctis, perdurantibus cincti", so daß unser Pilz zu dieser Gattung nicht gehören kann.

2020. **Ceratostomella cirrhosa** (Pers.) Sacc. Syll. I p. 408, f. it. del. 345.

Cfr. Winter Pyr. p. 250, Schröter l. c. p. 311, Ell. et Ev. N. am. Pyr. p. 196, Kirschstein: Pilze Brandenburgs p. 246.

Exs.: Fuckel f. rhen. 1804!, Plowr. Sphaer. brit. III 54,? Cooke f. brit. II 684 (mein Explr. unbrauchbar).

In einer faulen Weide bei Wiebelsheim/Windsheim in Mittelfranken. Dr. Rehm.

2021. **Dothidea natans** (Tode) Zahlbr. f. **Sambuci** Pers..

Cfr. Rehm Ann. myc. VI p. 521.

An dürren Ästen von *Sambucus nigra* am Sonntagberg in N.-Österreich, leg. Strasser, am Taubenberg in den bayr. Voralpen. Rehm.

2022. **Ustulina maxima** (Weber) Wettstein (Verh. z. bot. Ges. 1885 p. 592).

Cfr. Sacc. Syll. I p. 351, f. it. del. 1193, Schröter Schles. p. 465, Winter Pyr. p. 869, Traverso fl. it. cr. p. 36, Ell. et Ev. N. am. f. p. 662 pl. 39.

Exs.: Fuckel f. rhen. 1063, Bad. Crypt. 431, Schweiz. Crypt. 112, Moug. et Nestl. St. vog. 276, Sacc. Myc. Ven. 255, Kunze f. sel. 154, Rabh. hb. myc. II 145, Cooke f. brit. II 465, Plowright Sphaer. brit. I 15, Thümen f. austr. 665, Linhart f. hung. 182, Sydow Myc. march. 863, 1549, 1653, Allescher & Schnabl f. bav. 452, Krieger f. sax. 1334, Ellis N. am. f. 860.

An faulenden *Fagus*-Stöcken im Wald bei Lohr im Spessart, im Isartal bei München. Rehm.

2023. **Eutypella scoparia** (Schwein.) Ell. et Ev. N. Am. Pyr. p. 495.

Exs.: Ellis et Ev. N. am. f. 2117, 2517.

On *Ulmus americana* near London/Ont. Canada. Dearness.

2024. **Valsa cornina** Peck.

Cfr. E. et Ev. N. Am. Pyr. p. 478.

Exs.: E. et Ev. N. Am. f. 3434.

On *Cornus stolonifera* near London/Ont. Canada. Dearness.

2025. **Valsa saccharina** Rehm n. sp.

On *Acer saccharinum* near London/Ont. Canada. Dearness.

Stromata cortici interiori haud mutatae innata, primitus solitaria, c. 2 mm lat., dein longitudinaliter coacervata, epidermidem in striis plus minusve perpendiculariter parallelis, —5 cm longis perrumpentia ibique disculos atros seriatos denudantia. Perithecia 10—15 orbiculariter monostiche congregata, 0,15 mm lata, atra, glabra, globosa, collis in disculum atrum, planum, c. 0,3 mm lat. confluentibus ibique coalitis, papillulis minutissimis hemisphaericis prominentibus. Asci clavati, 30—35 ⩽ 8—9 μ 8-spori. Sporae allantoideae, hyalinae, 10—14 ⩽ 2,5—3 μ, 2—3-stichae. Paraphyses filiformes.

(Die ganze äußere Rinde erscheint durch die vorbrechenden Stromata mehr weniger verbreitet längsgestreift und sind diese Streifen durch die kleinen Scheiben schwarz punktiert. Durch dieses eigentümliche Wachstum in zarter Rindenschicht ist der Pilz von *Valsa exigua* Nke. besonders verschieden.)

503c. **Geoglossum ophioglossoides** (L.) Sacc.

Bei Spalt in Mittelfranken, leg. Beckenbauer.

1882b. **Tryblidiopsis pinastri** (Pers.) Karst.

An Ästen von *Pinus Larix* bei Sugenheim in Mittelfranken. Rehm.

1012b. **Phragmonaevia exigua** (Nießl) Rehm.

Cfr. Ber. bayr. bot. Ges. XIII p. 151.

An Stengeln von *Rubus suberectus*. Triglitz in der Priegnitz. Jaap.

469b. **Stictis arundinacea** Pers.

Grashalme in der Kienbach-Schlucht bei Andechs in Oberbayern. Rehm.

30b. **Ostropa cinerea** (Pers.) Fr.

An Ästen von *Fraxinus excelsior* bei Sugenheim in Mittelfranken. Rehm.

584b. **Pseudovalsa Betulae** (Schum.) Schröter.

Cfr. Rehm: Ann. myc. IV p. 481.

An Ästen von *Betula* im Park Neufriedenheim/München. Rehm.

730c. **Eutypella stellulata** (Fr.) Sacc. f. **diatrypeoides** Rehm.

On *Ulmus americana* near London/Ont. Canada. Dearness.

82b. **Valsa salicina** (Pers.) Fr. f. *octospora*.

On *Salix* near London/Ont. Canada. Dearness.

666b. **Valsa ambiens** (Pers.) Fr. f. **Ulmi** f. **octospora**.

Cfr. Trav. fl. it. cr. p. 193.

Exs.: Rehm Ascom. 666a, Krieger f. sax. 433, Sacc. Myc. Ven. 177.

An *Ulmus* bei Mährisch-Weißkirchen/Mähren, leg. Petrak.

(Rehm Asc. 666a scheint so verschieden, daß Krieger sein Exs. sub *Valsa salicina* ausgab, denn man sieht hier nur kleine weiße Scheiben mit Andeutung der Ostiola. Allein ich besitze von ihm an gleichem Ort zu gleicher Zeit gesammelte Exemplare, an denen deutliche ambiens-ostiola die weißliche Scheibe umrahmen.)

1769b. **Nummularia anthracina** (Kze. et Schm.) Traverso f. **juvenilis**.

An dürrem *Fagus*-Ast im Wald bei Weßling/Oberbayern. Rehm.

Studies on Pleurotus ostreatus Jacqu. and Pleurotus ulmarius Bull.[1])

By C. D. Learn.

(With Plates XVI—XVIII.)

A number of publications have appeared which deal with the destruction of wood caused by some of the higher fungi. These publications relate chiefly to members of the Polyporaceae. Comparatively little work has been done with the relation of the gill bearing fungi (Agaricaceae) to wood destruction. For this reason it has seemed desirable that certain members of this family should be studied. *Pleurotus ostreatus* Jacqu. and *Pleurotus ulmarius* Bull. were selected for this study[2]).

Pleurotus ostreatus Jacqu.

Pleurotus ostreatus is commonly known as the oyster agaric. Collections were made at various places in the vicinity of Ithaca, New York, from 1910 to 1912. Its large, white to dark gray fruit bodies are frequently to be seen growing in imbricated clusters on the decaying trunks of trees in the woods, or as a wound parasite on living trees. Plate XVI is a representation of the fungus in its characteristic appearance. It has been observed growing on oak, bass-wood, and elm. It appears as an annual from August to early December.

The pileus is convex, later it may become expanded and the margin upturned. Many pilei are usually formed in a cluster in an imbricate manner. The flesh is white. According to the descriptions and plates given by Cooke (10), Sowerby (30), Peck (21), and Atkinson (1), the pileus varies in color and shape. Brefeld (6) describes the pilei as having a bluish tone. The stem when present is short, firm, indistinct or entirely absent. When the plant grows on the upper side of the substratum there is often a distinct central stipe. In the usual position the pilei have mostly a lateral attachment. The stem is sometimes hairy at the base

[1]) Contribution from the Department of Botany, Cornell University, number 150.

[2]) The work was carried on in the Botanical Laboratory of Cornell University under the direction of Professor Geo. F. Atkinson to whom the writer is much indebted for the suggestion of the problem and for constant attention throughout the work; and to Dr. F. McAllister for many helpful suggestions regarding the staining of the material for microscopic study.

and sometimes the pileus is sessile. The gills are white, broad, decurrent, subdistant, anastomosing at the base in a coarse reticulum over the stem. The spores are oblong, 3,4—5,15 μ broad by 6,9—10,35 μ long. They are a lilac color in mass on white paper. An individual spore is white as observed under the microscope, corresponding to the color given by writers describing the species. The spores in mass retain their lilac color for some time.

The characters of *Pleurotus ostreatus* and *Pleurotus sapidus* are so nearly alike that Peck (20) separates the species by the color of the spores. The spores of the latter are said to be pale lilac while those of the former are described as white. *Pleurotus euosmus* Berkeley has lilac spores, but Massee (18) treats this as a variety of *Pleurotus ostreatus*. Berkeley (4) says the spores of *Pleurotus euosmus* are lilac in color and does not mention the color of the spores of *Pleurotus ostreatus*. Saccardo (23) states that the color of the spores in *Pleurotus sapidus* and *Pleurotus euosmus* are lilac, but does not give the color for *Pleurotus ostreatus*.

Yet there are other characters which are used to separate *Pleurotus ostreatus* and *Pleurotus sapidus*. In the former the spores are smaller, pilei broader, stem when present is shorter, and two or more stems do not arise from a common base as in *Pleurotus sapidus*.

Spore germination: The spores were obtained at various times from many different specimens by placing pilei in a moist chamber and allowing the spores to fall in sterilized petri dishes. The spores were all preserved for study and germination in sterilized petri dishes.

The culture media used were distilled water, tap water, bean agar, and bean pods in test-tubes. To avoid any chance for contamination of cultures, all receptacles used were carefully sterilized.

Van Tieghem cells containing tap water and distilled water were used for observing spore germination. For observation of the development of the mycelium, and as a source from which to obtain other cultures by inoculation, petri dishes containing bean agar were used.

Before germination the spores became vacuolate (Fig. 1). The germ tube appears to come from one or both ends of the spore. I have never observed them to germinate from the side. They germinate very readily in any of the above named media. The time of germination varies from three to four days. Spores kept in the laboratory from October germinated quite freely on February 16 in distilled water after four days.

The mycelium branches profusely soon after germination, but cross walls are not very numerous until much later. A dense weft of hyphae is formed over the surface of bean agar in petri dishes after fourteen to twenty days. The germ tubes soon become almost as thick as the spores, and after a few days growth it is with difficulty that one can distinguish the position of the germinating spore in the colony of mycelium

(Fig. 1). The mycelium from pure cultures showed many clamp connections. Conidia of the oidia type were also formed (Fig. 3). I had suspected that conidia were present in cultures on blocks of wood for new growths were formed at the base of cultures, suggesting the shedding of spores.

Pure cultures were also obtained by transferring a portion of the trama of the pileus to bean pods in testtubes, and also on blocks of bass-wood *(Tilia americana)*, and oak *(Quercus rubra)*, previously sterilized. In the case of wood, which I found very difficult to get free from contaminations, it was sterilized four to five times after a day's interval between each sterilization. The wood blocks were placed in large bottles stoppered with cotton-wool.

On bean pods growth was noticed in three to four days, and in seven days the entire block of the fungus transferred was covered with a fine white growth of mycelium. The growth was quite rapid until the surface of the bean pod was covered. In only one instance were fruit bodies formed and these were small and abnormal. Cultures on wood gave the same characteristic growth, and after seven to eight months abnormal fruiting bodies began to form. Clusters of one to five fruiting bodies sprang up after intervals of fourteen to twenty-four days, but none ever reached a normal form or size.

Character of the normal wood: The wood of hard maple *(Acer saccharum)*, is of the diffuse porous type. Most of the pith rays are broader than the pores and very conspicouous. The vessels are uniformly distributed throughout a year's growth and all are approximately of the same size. The pith rays are narrow and numerous. The wood cells formed in the spring are larger than those formed in the summer, containing more water and they are not as thick walled.

Effect of the mycelium on the wood: The diseased wood used for making sections for microscopical study was obtained from hard maple *(Acer saccharum)*, where a cluster of fruiting bodies was formed. This portion was a small area from the main trunk of an actively growing tree. The gross characters of the wood, which has been rotted by *Pleurotus ostreatus*, possess somewhat of a characteristic appearance in the species studied. A dark brown line marks the limits of the attacked portion. The area enclosed by this brown line is much whiter, resembling the white rot of *Polyporus igniarius*, although in the case of the rot caused by *Pleurotus ostreatus* the line marking off the diseased area is not as definite. The wood is much lighter in weight, flaky, and the fibers are easily separated.

In order to observe the action of the hyphae on the wood the following methods were employed. Diseased wood was sawed into convenient blocks, which were boiled to fix the hyphae (in-situ), and then passed

through 95 per cent alcohol, absolute alcohol, ether alcohol, and imbedded in celloidin.

In preparing sections for microscopical study the following stains were employed: Delafield's haemotoxylon and Congo red, Gentian violet and Congo red as described by Biffen (5), Safranin and Hoffman's blue as described by Fischer (15), and Ruthenium red and methyl green as described by Fischer (15). The latter stain I found to give the best results especially for following the course of the hyphae in the tissues. This stain I found far superior to any other used. It was prepared according to Eisen (12)[1]).

The method of staining which I found after many trials to be the most satisfactory, was as follows. The sections were first soaked in a solution of 75 per cent alcohol and 25 per cent hydrochloric acid for 30—45 minutes, and then washed in 50 per cent ammonia. The material was transferred directly to ruthenium red staining from $^1/_2$—$^3/_4$ hour; transferred to methyl green where it was left for one-half the time; then washed in water, dehydrated in 30 per cent, 50 per cent, 65 per cent, 70 per cent, 80 per cent, and 95 per cent alcohols. Clear in Eycleshymer's fluid. If there is any deviation I should stain longer in ruthenium red and less in methyl green. Ruthenium red not only stains the hyphae, but it likewise stains the lignin a beautiful pink as stated by Fischer (15).

For the detailed study of the relation of the mycelium to the wood numerous sections were prepared and examined with the microscope. The hyphae appear to traverse the vessels more abundantly than any other tissue. They may follow the course of a vessel for some distance before diverging, and again they may branch off profusely entering the medullary rays. In the much decayed wood the mycelium is abundant in the large vessels and medullary rays. Extending from the large vessels the fungus hyphae pass freely to the medullary rays through the pits. In some places there was observed a swelling of the hypha previous to the perforation of the cell wall (Fig. 4). Shortly after a hypha has passed through a pit the latter often enlarges forming an irregular hole in the wall: and as the solution of the walls continues two or more holes may coalesce and nearly sever the fiber (Fig. 6). Figure 6 shows a fiber taken from a much decayed portion isolated by Schultze's maceration method. Upon applying chlorzinc-iodine the entire fiber reacted for

[1]) Eisen says, „Ruthenium red (Grubler) is a very expensive stain, but happily very small quantities will do. The ruthenium red is dissolved in a mixture of 80 % distilled and filtered water, 10 % absolute alcohol, and 10 % glycerine, which latter must be as absolutely pure as can be procured. Unfortunately this mixture is apt to degenerate and oxidise in a few weeks, and only a very small quantity should therefore be prepared at a time, preferably a day or two before using. When spoiled the mixture will stain yellowish brown instead of red."

cellulose, giving a stronger reaction about the cavities. Figure 6 at *c* shows a normal pore while *f* shows one enlarged by the action of the enzyme secreted by a hypha. Many cross walls are formed in the mycelium. In the medullary rays the hyphae assume very irregular shapes. They measure from 5,75—6,9 μ in diameter.

In the very badly decayed wood the mycelium seems to disentegrate, leaving only the large very irregular holes which are very numerous as shown in Fig. 19. In the final stage the cells of the medullary rays are entirely broken down, leaving only scattered fragments of the middle lamella. In tangential section many of the medullary ray cells as well as some vessels appear to be filled with a brown substance. This compound is probably some decomposition product thrown down by the action of the fungus. Von Schrenk (25) shows that such products are precipitated by the action of *Polyporus pinicola* in Birches and *Trametes pini* in Spruce, Tamarack and Fir.

Chemical changes in rotting wood: Due to composition of the wood it seems evident that structural alterations must take place, which are caused by the great chemical changes. Cross sections of diseased wood treated with phloroglucin and HCl, and compared with normal wood, reveal the action of the fungus. The area bordering on the lumen of the cell colors a light pink, the red color becoming more intense through the secondary lamella to the primary lamella. At the middle lamella the cell walls stain a deep dark red. This is a very characteristic reaction for lignin, and Fig. 9 is intended to represent it. Figure 10 represents a section of diseased wood treated with phloroglucin and HCl. Only a slight delignification has taken place as many of the cells give a definite lignin test. Those at *a* were slightly delignified. The tertiary portion remains colorless and the size of the lumen increases. Figure 11 represents a more advanced stage where the secondary lamellae have disappeared, the lumen area is very much increased in size, and the middle lamella is the last to be delignified. The group of cells at *c* are intended to represent the very slight delignification. In an advanced condition of delignification the middle lamella is all that remains. As the cells become delignified the lumen area increases in size, and the delignified secondary lamella does not remain behind as a swollen mass as is the case when wood is affected with *Pleurotus ulmarius* described below. Marshall Ward (34) shows that the secondary lamellae are detached from the primary lamella and remain colorless in a distorted mass in wood affected by *Stereum hirsutum;* and C. E. Fischer (15) finds the same condition in the case of wood affected by *Armillaria mucida.*

According to Zimmerman (35) the color reactions of lignified cell walls are characteristic of the different reagents. Aniline chloride added in aqueous solution with HCl colors lignified cell walls a golden yellow. Anilin sulphate added in concentrated aqueous solution with H_2SO_4 gives

the same color reaction. Thallin sulphate added in concentrated solution in mixture of one volume of alcohol and one of water colors lignin yellow to dark orange yellow. If to a concentrated aqueous solution of phenol is added as much $KClO_3$ as it will dissolve, and this solution is added simultaneously with HCl it colors lignin blue or greenish blue.

All the above lignin tests were used. Wood sections treated with thallin sulphate give a permanent color reaction, while the others do not.

Tests for the presence or absence of cellulose were made with chlorzinc-iodine, also with iodine and sulphuric acid. Normal wood treated with chlorzinc-iodine shows that cellulose is present in small quantities surrounding the lumen, and in the secondary lamellae of some cells, while others are completely lignified. In sections of wood treated with chlorzinc-iodine the disappearing cell walls are colored a blue or purple and the lignin yellow. Figure 8 of diseased wood shows the lumen of the cell much larger than in Fig. 7, which is from normal wood. The results obtained for cellulose indicate that there is a gradual delignification of the cell wall proceeding from the lumen outwards.

The medullary rays seem to persist longer. According to Von Schrenck (25) wood infected with *Polyporus pinicola* gives no reaction whatever for cellulose appearing as if it had been completely destroyed. In wood affected by *Pleurotus ostreatus* the lumen enlarges but delignification precedes it. It is evident from the above reaction that the hyphae attack first the tertiary lamellae and extend their action outwards, until in the very last stage the middle lamellae may be broken down. The reduction of the lignified tissue to cellulose is a very slow process.

Observing a cross section of wood containing several years' growth with a low power, there appears a marked difference for the lignin reduction in the diseased wood. The spring wood was almost completely delignified, while the summer wood retained its lignin characters in a more pronounced manner. That there is a difference in the consistency of the spring and summer growths is very evident. The former is laid down much faster and has thinner walls than the latter; under such conditions the spring wood might be more susceptible to attack than the thicker, firmer cells formed during the season when growth is less rapid.

Spaulding (32) has shown that on boiling wood the spring area seemed wholly delignified, while the summer wood still retained its lignin characters apparently showing little change. From the chemical and boiling tests he concluded that the lignin of the spring wood is not held in combination as firmly as it is in the summer wood.

That the disentegration of the wood is caused by the action of some enzyme secreted by the mycelium of the fungus seems not at all improbable. With this in view I tested fruit bodies of the fungus for the purpose of determining the presence or absence of two important enzymes. I did

not have enough mycelium formed in the diseased wood nor in cultures to make the study, but thinking the enzymes might appear in the sporophores as well as in the mycelium I used them for the demonstration.

I pulverized 10 g of dried fruit bodies, and put this to soak in 20 per cent alcohol and distilled water. I filtered the mixture and to the filtered extract obtained, I added two and one-half times its volume of absolute alcohol to precipitate the enzymes. Soon a white flaky substance began to appear. The mixture was filtered again, and the precipitate was obtained on the filter paper. After washing the material several times in ether the precipitate was dissolved in 100 c. c. of distilled water. The solution obtained was light yellow in color.

In testing for diastase 1. c. c. of the extract was added to 20 c. c. of a 5 per cent solution of soluble starch in a test-tube (a). For control I used one test-tube (c) containing only soluble starch, an another (b) in which the extract was boiled for 10 minutes before adding the soluble starch. The tubes were kept at the temperature of the laboratory.

After sixteen hours 5 c. c. of the solution in each (a), (b) and (c) was added to 5 c. c. of Fehling's solution and boiled for ten minutes. The Fehling's solution was almost completely reduced in (a), the blue entirely disappearing and a dense bright red precipitate of cuprous oxide was thrown down. The controls were both treated in the same manner, and (b) gave a slight precipitate but the blue color was still present, while (c) gave no indication of a reduction of the Fehling's solution, the solution remaining unchanged in color. The slight reduction of Fehling's solution in (b) may be due to not boiling the extract properly before adding the starch.

The presence of diastase was shown in another way. A drop of iodine was added to a few c. c. of extract of preparation (a) which changed the color of the solution to a pale pink; while a solution of preparation (b) treated in the same manner gave the characteristic starch reaction. This indicates that the starch had been changed to glucose.

According to Czapek(11) *Merulius lacrymans* produces an enzyme which is capable of splitting hadromal from cellulose. He regards these bodies as being united in an ethereal-like compound in lignified membranes.

Tests for hadromal were made on delignified wood according to the methods employed by Czapek(11).

Some of the most rotten wood was ground to a fine powder and left to soak in cold water for several days. The filtered extract did not give the phloroglucin reaction. I then powdered some more of the wood and left it to soak in 90 per cent alcohol for an hour. At the end of that time the filtered extract gave a bright red color with the phloroglucin test. This shows that hadromal is still left behind in considerable quantities in the cell walls. According to the results obtained hadromal is not entirely

removed, while if there is a reduction of the hadromal it must be in very small quantities. Hadromal is also left behind in wood rotted by *Merulius lacrymans* according to Czapek(11) and by *Polyporus squamosus* according to Buller(9). It is not destroyed by *Polystictus versicolor* according to Miss Bayliss(3).

Pleurotus ulmarius Bull.

Pleurotus ulmarius is commonly known as the Elm pleurotus. It is a conspicuous object, growing as it does from wounds on living trees or on dead branches or trunks of the elm. It is not at all uncommon to see this mushroom late in autumn, growing from the wounds of elm trees where they have been improperly or severely pruned, where they have been planted as shade trees along the streets of our cities and in our public parks. Collections were made at various places about Ithaca, New York, and in no instance did I observe it growing on any other host than the elm. Peck(20) reports it as growing on maple and poplar. Pammel(19) reports it on box-elder and bass-wood in Iowa, and as being a very active agent in destroying the wood of box-elder *(Negundo aceroides)*. His illustration however is not that of *Pleurotus ulmarius*, but suggests *Pleurotus ostreatus*.

Fruiting bodies may be formed singly or in clusters of two or several. It is an annual and appears from August to early December. It is a large species easily distinguished from the oyster agaric and closely related species by its long stem attached usually near the center of the cap, and by its broad, sharply sinuate gills.

The pileus is broadly convex or nearly plane, glabrous or nearly so and usually white to whitish. The margin of the pileus is incurved. At times the center of the cap shows a rusty yellowish tinge. Sometimes the cuticle is cracked at the center into small areas giving it a scaly appearance, and occasionally it cracks radially. The flesh is firm and white. The cap varies from 7,5—20 cm. broad and from 1,75—2,5 cm. thick. Sowerby(31) states that the pileus frequently becomes 60—90 cm. in circumference.

The stem is firm, solid, and united to the pileus a little to one side of the center or near the margin. When growing from the side of the trunk of a tree the stem is more or less curved and eccentric; if growing on the upper side of the substratum the stem is central or nearly so and erect. It varies in length from 5—20 cm. and in thickness from 4—4,5 cm. The stem is commonly smooth, white or whitish.

The gills are 1,5—2 cm. broad and rather distant. They are adnexed and deeply sinuate next the stem. In color they are white, or when old tinged with yellow.

The spores are white, globose, and 5,5—8 μ in diameter.

Spore germination: By placing fresh fruit bodies in a moist chamber for several hours a quantity of spores may be obtained. For

studying the spore and its germination they were obtained as stated above in sterilized petri dishes. The spores used for study were taken from various specimens at various times.

Spores were germinated in distilled and tap water in Van Tieghem cells. Prior to germination the spores became vacuolate. There is no definite place of germination. One or two germ tubes may arise from the same spore. The spores germinate quite readily in three to six days. Spores which were kept in the laboratory from October germinated very sparingly on February 16 in distilled water after four days.

The mycelium branches profusely soon after germination, but cross walls are not very numerous until much later. Growth in bean agar is not as profuse as in the case of *Pleurotus ostreatus*. The position of the spore in the mycelium at an advanced state of growth is not difficult to observe, probably due to a great extent to its globoid shape.

For observing the development of the mycelium and as a source from which to obtain other cultures by inoculation, petri dishes containing bean agar were used. Pure cultures were also obtained by transfer of a portion of the trama of the pileus to bean pods in test-tubes, and also on blocks of elm wood *(Ulmus americana)*, previously sterilized. The wood blocks were placed in large bottles stoppered with cotton-wool. All material was thoroughly sterilized.

On bean pods inoculated with tissue cultures growth was noticed in five to six days, being much slower than in *Pleurotus ostreatus*. Some after eight days showed but very slight growth, and after thirty days in many cultures the bean pods were only covered with a fine growth of mycelium. No evidence of fruiting bodies was observed in test-tube cultures. Tissue cultures on blocks of elm wood gave the same characteristic mycelial growth, but it seemed to be more rapid than on bean pods. In only one instance were abnormal fruiting bodies formed after seven months.

The mycelium formed in cultures branched quite profusely and numerous clamp connections were formed. The mycelium varies in diameter from 2,3—3,45 μ. Diligent search was made for conidia but none were observed.

The wood of the white elm *(Ulmus americana)*, is of the diffuse porous type. The rings are well defined by the zone of large vessels, which consists of a single row. The small vessels of the summer wood are grouped several to many together, which form almost continuous wavy concentric lines or bands. The pith rays are numerous, and do not show very conspicuously, varying much in width.

The diseased wood used for study was obtained from a place where a cluster of fruiting bodies was formed. The wood rotted by *Pleurotus ulmarius* is dark to very dark brown in color. In badly decayed wood thin sheets corresponding to a year's growth may be removed. The wood

looses its toughness becoming very brittle. The decay begins in the heart wood and by gradual decomposition destroys it and then infects the sap wood.

For studying the action of the hyphae on the wood the methods used were the same as for the study of *Pleurotus ostreatus*.

Many sections were examined under the microscope in order to determine the course of the hyphae in the wood. The hyphae were observed following the vessels more abundantly than any other tissue. Branches are formed which pass into the pith ray cells, but they are not very numerous. If the mycelium on making its way through a vessel sends out a branch and this is in proximity to a medullary ray, it appears to change its course and pass around the pith ray. Figure 21 shows the hyphae passing around the pith ray. Then upon reaching a vessel the hypha follows the course of the vessel in both directions. Threads of mycelium have been observed following vessels for some distance. The hyphae become constricted very much when passing through a pit (Fig. 20). Soon after a hypha passes through a pit the latter enlarges forming an irregular cavity in the wall; and as the solution of the walls continues two or more holes may coalesce forming a large irregular cavity. Figure 19 shows several such large cavities.

Falck (14) shows that the mycelium of *Lenzites abietina* follows the course of the vessels entering them through the pits; while the mycelium of *Stereum hirsutum*, according to Marshall Ward (34) is chiefly formed in the medullary rays. Wood affected by *Pleurotus ulmarius* may be removed in definite layers, corresponding to the area of the vessels formed in the spring wood. The vessels being large makes them conspicuous as the limits of the annual growth. In advanced stages of decay it appears as if the vessels and the immediate tissue surrounding them were the chief elements attacked.

In decayed wood the mycelium has numerous cross walls. The mycelium varies in diameter from 3,45—5,75 μ. The mycelium present in much decayed wood is smaller in diameter.

Chemical changes in rotting wood: Normal wood treated with phloroglucin and HCl shows the cells are not entirely lignified. Many of the cells, in the area surrounding the lumen and in some the greater part of the secondary lamellae, gave no lignin reaction. The middle lamella stained a bright red color with a gradual fading towards the lumen. Figure 17 is from a section of normal wood indicating the character of the reaction.

Figure 18 is from a section of diseased wood treated with phloroglucin and HCl. The first noticeable feature is the secondary lamella of the cell. It remains as a colorless swollen mass, broken away from the middle lamella. In *Pleurotus ostreatus* the lumen of the cell grows larger

and the secondary lamella does not remain as an irregular body. Several cells are seen disconnected due to the dissolving away of the middle lamella. At *d* is shown only an isolated fragment of the primary lamella remaining. The delignification of the lignin is very evident, if the reaction of phloroglucin and HCl are to be relied upon.

The other reagents used for differentiating lignin were aniline chloride, anilin sulphate, thallin sulphate, and phenol. They all gave their characteristic reaction, as stated for *Pleurotus ostreatus*.

Normal wood treated with chlorzinc-iodine demonstrated the presence of quite a little cellulose. The tertiary lamellae of many cells, as well as the secondary lamellae, gave the reaction for cellulose. The middle lamellae and pith rays were colored yellow showing they were lignified. The reaction with chlorzinc-iodine showed there was more cellulose present in the elm than in the maple.

Diseased wood treated with chlorzinc-iodine colors the cellulose violet and lignin yellow; while iodine, potassium iodide and H_2SO_4 colors delignified tissue light to dark blue, and lignin a golden yellow. Each reagent gave its charcteristic reaction in decayed wood. Sections of decayed wood treated with chlorzinc-iodine show that there is delignification of the lignin. The entire cell gave an intense violet color. The results obtained conform to those with phloroglucin and HCl in regard to the secondary lamella. It is broken away from the primary lamella, and remains as a swollen irregular mass. The cell cavity does not increase very much in size.

From the results obtained it is apparent that the fungus mycelium attacks first the tertiary area and proceeds toward the primary lamella, which is the last to be destroyed.

Tests for diastase and hadromase: Diastase was found in the fruit bodies of *Pleurotus ulmarius*. The method for determining its presence was the same as that employed in *Pleurotus ostreatus*. Several tests were made before I obtained evidence of the presence of diastase. This evidence was so very slight that I sought to obtain more definite results. I used 10 c. c. of the fungus extract to 5 c. c. of the starch solution, and this gave results comparable to those with *Pleurotus ostreatus*. This shows that the enzyme diastase is not present in such quantities as in the former species studied.

The tests for hadromase were negative.

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Explanation of Plates.

Plate XVI.

Pleurotus ostreatus on maple.

Plate XVII.

Pleurotus ostreatus.

Fig. 1. Spores, germination, and mycelium formed three days after germination.

Fig. 2. Hyphae taken from culture on bean pod after five days inoculation from trama of pileus.

Fig. 3. Conidia obtained from pure culture on bean pod.

Fig. 4. Tangential section of *Acer saccharum* showing the mycelium.

Fig. 5. Another tangential section of *Acer saccharum* showing the constriction of the mycelium, and its location in the medullary ray.

Fig. 6. Fiber from wood of *Acer saccharum* badly corroded by the action of the mycelium, and isolated by Schultze's maceration method. *e* is a normal pit, *f* is a pit enlarged by the action of enzymes secreted by the mycelium.

Fig. 7. Transverse section of normal wood of *Acer saccharum* treated with chlorzinc-iodine. All the cells stained yellow giving no reaction for cellulose.

Fig. 8. Transverse section of diseased wood of *Acer saccharum* treated with chlorzinc-iodine. The shaded portion represents the cellulose which gives a stronger reaction in the area surrounding the lumen, and fading away towards the middle lamella.

Fig. 9. Cross-section of normal wood of *Acer saccharum* treated with phloroglucin and HCl. The cells all stained red, which become more pronounced toward the middle lamella. The primary lamella stained a very dark red.

Fig. 10. Cross-section of diseased wood of *Acer saccharum* treated with phloroglucin and HCl. The shaded portions represent lignin reaction, while the unshaded as at *a* and the light shaded show cellulose to be present.

Fig. 11. A more advanced stage of decay of *Acer saccharum* treated with phloroglucin and HCl. At *b* there are only isolated parts of the middle lamellae remaining, while *c* shows a few cells staining nearly normal. The lumen of the cells are very large and in most of the cells the secondary lamellae have disappeared.

Pleurotus ulmarius.

Fig. 12. Spore, and germination after four days.

Fig. 13. Hyphae formed in bean agar after four and a half days.

Fig. 14. Hyphae taken from pure cultures on bean pod. These show the branching and clamp connections.

Fig. 15. Cross-section of normal wood of *Ulmus americana* treated with chlorzinc-iodine. The shaded portions represent the purple stain for cellulose.

Fig. 16. Transverse section of diseased wood of *Ulmus americana* treated with chlorzinc-iodine. The shaded portions represent the presence of cellulose. The middle lamellae shown here stain yellow.

Fig. 17. Cross-section of normal wood of *Ulmus americana* treated with phloroglucin and HCl. The shaded parts represent the lignin. Some cells did not react for lignin, while others showed the presence of cellulose at the tertiary lamella.

Fig. 18. Cross-section of diseased wood of *Ulmus americana* treated with phloroglucin and HCl. The shaded portions represent the lignin which stained red. At *d* there is an isolated portion of the middle lamella. The secondary lamellae are detached from the primary lamellae and remain as a swollen mass.

Fig. 19. Section showing pits in the vessels, and the large holes made by the hyphae.

Fig. 20. Tangential section of elm wood *(Ulmus americana)*, showing the mycelium and its constrictions.

Fig. 21. Tangential section of wood of *Ulmus americana* showing the character of the mycelium.

Plate XVIII.

Tangential view of maple wood *(Acer saccharum)*, affected with *Pleurotus ostreatus*. Magnification, 112 diameters with the exception of Fig. 22.

Fig. 22. A large affected area and general distribution of the mycelium.

Fig. 23. The mycelium following the course of the vessels.

Fig. 24. The mycelium spreading from vessel to vessel.

Fig. 25. The mycelium in the vessels and cells of the medullary ray, and constriction of the hyphae.

Tangential view of elm wood *(Ulmus americana)*, affected with *Pleurotus ulmarius*. Magnification, 112 diameters.

Fig. 26. Mycelium spreading in the vessels.

Fig. 27. Mycelium larger in diameter passing around the medullary ray, and branching off through the vessels.

Infektionsversuche mit parasitischen Pilzen, III.

Von O. Treboux.

21. In betreff der Aecidiumwirte von *Puccinia Polygoni-amphibii* Pers. (s. No. 15 in Infektionsversuche II, Ann. Mycol. vol. X, p. 303) habe ich nachzutragen, daß ich außer auf *Geranium pratense* und *G. collinum* auch auf *G. divaricatum* Ehrh. sehr reichlich Aecidien erhalten habe. Im Gegensatz zu meiner früheren Angabe treten Aecidien aber auch auf *G. columbinum* L. und *G. rotundifolium* L. auf. Bei *G. columbinum* sah ich die Aecidien nur an Blattstielen (bis 35 Infektionsstellen), bei *G. rotundifolium* sowohl an Blattstielen (bis 60 Infektionsstellen) als auch an Blattspreiten. Auf letzteren unterblieb anfänglich die Aecidiumbildung, indem das Blattgewebe an den Infektionsstellen bald abstarb. Dieser Umstand führte dazu, daß ich das positive Resultat meiner Versuche zunächst übersah. Nicht infiziert werden *Geranium purpureum* Vill., *G. Robertianum* L. und *G. sanguineum* L.

22. Zu den *Allium*-Arten, die nach Aussaat der Teleutosporen von *Puccinia permixta* Syd. auf *Diplachne serotina* Lk. Aecidien erzeugen (s. No. 12, Infektionsversuche II), gehören nach weiteren Versuchen auch *Allium globosum* M. B., *A. porrum* L. und *A. sativum* L.

23. Von Herrn W. Tranzschel wurde ich darauf aufmerksam gemacht, daß ein hier auf *Lamium amplexicaule* L. von mir gefundenes Aecidium zu seiner *Puccinia stipina* zu stellen sein dürfte. Dies fand sich in meinen Versuchen wiederholt bestätigt, indem die aus Samen gezogenen Pflanzen von *Lamium amplexicaule* 12—14 Tage nach Aussaat der Teleutosporen von *Stipa capillata* L. reichlich Aecidien bildeten. Nachdem *Puccinia stipina* von *Stipa capillata* auf diese Weise schon auf fünf Gattungen aus der Familie der Labiatae (*Thymus*, *Salvia*, *Ajuga*, *Origanum* und *Lamium*) sich hatte übertragen lassen (s. Infektionsversuche II), suchte ich die Pleophagie dieses Pilzes durch Versuche mit weiteren Labiaten zu bekräftigen. In einem botanischen Garten wäre dies Unternehmen sicherlich von noch größerem Erfolge gewesen; denn unter den wenigen mir zugänglichen, der hiesigen Flora entnommenen Labiaten fanden sich schon in vier weiteren Gattungen Aecidiumwirte, nämlich *Glechoma hederaceum* L., *Lallemantia iberica* F. et M. (= *Dracocephalum ibericum* Stev.), *Leonurus cardiaca* L. und *Stachys recta* L. Bei Versuchen mit *Glechoma hederaceum* und *Leo-*

nurus cardiaca wurden Spermogonien in großer Menge gebildet, aber nur hier und dort trat auch Aecidienbildung auf. Negativ fielen die Versuche mit *Ajuga genevensis* L., *Ballota nigra* L., *Marrubium praecox* Janka, *Nepeta ucrainica* L., *Phlomis tuberosa* L., *P. herba venti* L. var. *pungens* MB. und *Teucrium polium* L. aus. Dies gilt auch für *Geranium sanguineum* L., mit dem ich die Versuche mehrere Male wiederholte, da nach Tranzschel auf dieser Pflanze vorkommende Aecidien ihrem Bau nach solchen von *P. stipina* entsprechen.

Die Versuche mit *Puccinia stipina* in Infektionsversuche I, No. 10 muß ich dahin berichtigen, daß das Teleutosporenmaterial nicht von *Stipa Lessingiana* Trin., sondern von *S. capillata* L. herstammte.

24. Im Frühjahr sammelte ich *Carex stenophylla* Wahlenb. mit gut keimenden *Puccinia*-Teleutosporen, die ich auf Grund des Versuches No. 8 der Infektionsversuche I, d. h. der Infektion von *C. stenophylla* mit Aecidien auf *Taraxacum serotinum* W. K., zur Rückinfektion von *Taraxacum*-Arten verwenden wollte. Die Versuche waren jedoch ohne Erfolg. Später beobachtete ich zwischen den schon ausgekeimte Teleutosporen tragenden *C. stenophylla*-Pflanzen *Centaurea trichocephala* M. B., die stark mit Aecidien behaftet war. In einiger Entfernung von der *Carex* waren die *Centaurea*-Pflanzen ohne Aecidien. Durch Aussaat der Aecidiosporen von *C. trichocephala* erzielte ich eine starke Bildung von Uredo- und darauf Teleutosporenlager auf *C. stenophylla*, keine auf *Carex nutans* Host. Das Aecidium auf *C. stenophylla* wird in Sydow's Uredineae exsiccatae ausgegeben werden.

25. In Livland von mir gesammelte Uredosporen von *Puccinia glumarum* Erikss. et Henn. auf *Agropyrum (Triticum) repens* P. B. benutzte ich daselbst zu Versuchen zwecks Feststellung von etwaigen biologischen Formen dieses Pilzes. Am zwölften Tage nach der Aussaat (12. 7.—24. 7.) traten bei *Agropyrum repens*, *Triticum vulgare* L., *Hordeum vulgare* L. und *Bromus mollis* L. an je einigen Infektionsstellen die charakteristischen Uredolager auf. Es liegen somit keine diesen Grasarten entsprechende biologische Formen vor. Wenn in meinen Versuchen *Agrostis alba* L. und *Calamagrostis epigeios* Roth nicht infiziert wurden, so lag dies vielleicht nur daran, daß mir nur wenig und schlecht keimendes Impfmaterial zur Verfügung stand.

26. *Puccinia agropyrina* Erikss. auf *Agropyrum repens* P. B ist wahrscheinlich nicht als biologische Art von *P. dispersa* Erikss. et Henn. auf *Secale cereale* L. zu scheiden. Mit Uredosporen von *P. dispersa* auf *Agropyrum repens* erzielte ich eine starke Infektion sowohl von *A. repens* als auch von *Secale cereale* L. am 9. Tage nach der Aussaat. Später beobachtete ich auch die Teleutosporenbildung. Die auf *S. cereale* erhaltenen Uredosporen erzeugten wieder *P. dispersa* auf *Agropyrum repens*. Diesbezügliche Versuche mit *Anchusa* beabsichtige ich bei Gelegenheit anzustellen.

27. In der Umgegend von Nowotscherkask fehlt *Rhamnus franguia* L. und kommt von *Rhamnus*-Arten nur *R. cathartica* L. vor. Die *R. cathartica*-

Sträucher sind jedes Jahr stark vom Aecidium, und unter den Gräsern *Agropyrum repens* P. B., *Bromus inermis* Leyss., *Calamagrostis epigeios* Roth. und *Festuca elatior* L. stark von der *Puccinia* des *coronata*-Typus befallen. Da ich nichts von den Arbeiten der letzten Zeit über *Puccinia coronata* Corda sens. lat. wußte und erst kürzlich mit den gewonnenen Resultaten durch die Arbeit Mühlethaler's bekannt wurde, stellte ich im vorigen Jahre Versuche an, die *Agropyrum repens* und *Bromus inermis* als Wirte von *P. coronifera* Kleb. nachweisen sollten. Mit den im Frühjahr eingesammelten Teleutosporen von *Agropyrum repens*, *Bromus inermis*, *Calamagrostis epigeios* und *Festuca elatior* erhielt ich in zwei Versuchsreihen zahlreiche Aecidien auf *Rhamnus cathartica* (15. 4.—8. 5.). Zu den Versuchen benutzte ich im Warmhause ausgetriebene Zweige von *R. cathartica*. Andererseits erhielt ich, von den im Freien gesammelten Aecidien auf *R. cathartica* ausgehend, in zwei Versuchsreihen nach 10—12 Tagen äußerst zahlreiche Uredo- und danach Teleutosporenlager von *P. coronifera* auf: *Agropyrum repens* P. B., *A. prostratum* Eichw., *Bromus inermis* Leyss., *B. tectorum* L., *B. squarrosus* L., *B. erectus* Huds., *Festuca elatior* L., *F. distans* Kunth. (= *Glyceria distans* Wahlenb.), *Avena sativa* L. und *Melica ciliata* (hierauf schwächere Infektion). Die Aussaat der auf *Agropyrum repens* aus Aecidiosporen von *R. cathartica* in größerer Menge erhaltenen Uredosporen führte zu starker Uredobildung von *P. coronifera* auf *Agropyrum prostratum*, *Avena sativa*, *Bromus squarrosus* und *B. tectorum* (24. 5.—3. 6.). Es erübrigt sich also, die Spezialformen f. sp. *Agropyri* und f. sp. *Bromi* aufzustellen. In diesem Jahre setzte ich die Versuche mit Aecidiosporen von *R. cathartica* in zwei Versuchsreihen fort. In der ersten (19. 5.—30. 5.) ging der Pilz auf folgende Gramineen über: *Alopecurus nigricans* W. (5 Versuche, III), *A. pratensis* L. (3 Versuche), *Arrhenatherum elatius* M. et K. (2 Versuche, III), *Avena brevis* Roth. (2 Versuche, III), *A. fatua* L. (3 Versuche, III), *A. orientalis* Schreb. (4 Versuche, III), *A. sativa* L. (III), *A. sterilis* L. (2 Versuche, III), *Brachypodium distachyum* R. et Sch., *B. silvaticum* R. et Sch. (III), *Dactylis glomerata* L. (2 Versuche, III), *Festuca arundinacea* Schreb. (2 Versuche), *F. distans* Kunth. (III), *F. elatior* L. (III), *Hierochloa odorata* Wahlenb., *Holcus setosus* Trin. (III), *Hordeum vulgare* L. (III), *Koeleria cristata* Pers., *Lolium perenne* L. (7 Versuche, III), *L. temulentum* L. (III), *Melica ciliata* L. (3 Versuche, III), *Phalaris arundinacea* L., *Poa annua* L. (III), *Polypogon monspeliensis* Desf., *Secale cereale* L. (2 Versuche, III), *Sesleria coerulea* Ard. (2 Versuche, III), *Triticum vulgare* L. III. In der zweiten Versuchsreihe (31. 5.—10. 6.) wurden infiziert: *Agropyrum glaucum* R. et Sch., *Agrostis stolonifera* L., *Aira caespitosa* L. (2 Versuche), *Avena sativa* L. (III), *Briza media* L., *Bromus albidus* M. B., *B. asper* Murr. (III), *B. erectus* Huds., *B. inermis* Leyss., *B. mollis* L. (III), *B. patulus* M. et K. (III), *B. secalinus* L., *B. tectorum* L., *Calamagrostis arundinacea* Roth, *C. epigeios* Roth (2 Versuche, III), *Eatonia obtusata* A. Gray, *Festuca arundinacea* Schreb., *F. elatior* L., *F. gigantea* Vill. (III), *F. ovina* L., *Hierochloa odorata* Wahlenb., *Koeleria cristata* Pers. (2 Versuche),

Melica ciliata L., *Phleum asperum* Vill. (2 Versuche, III), *Poa pratensis* L., *P. trivialis* L., *Sclerochloa dura* P. B., *Secale cereale* L. (III), *Sesleria coerulea* Ard. (2 Versuche), *Triticum vulgare* L. (III). Die beigefügte (III) bezeichnet, daß auch die Bildung der Teleutosporen früher oder später festgestellt wurde. Die Fälle, in denen Teleutosporen nicht beobachtet wurden, sind wohl nur auf äußere Umstände (zu kurze Beobachtungszeit oder vorzeitiges Zugrundegehen der Pflanzen) zurückzuführen. Alle in diesen Versuchsreihen infizierten Gräser müssen als Wirte von *Puccinia coronifera* betrachtet werden; eine zufällige Infektion durch Aecidiosporen von *Rhamnus frangula* oder anderen Arten ist ausgeschlossen, da im Gebiete, auch in Anpflanzungen, nur *R. cathartica* vorkommt.

Was die Unterscheidung von biologischen Formen anbetrifft, so ist hier folgendes zu bemerken. Besondere den Gattungen *Aira*, *Arhenatherum*, *Brachypodium*, *Eatonia*, *Holcus*, *Polypogon* und *Sesleria* entsprechende biologische Formen dürften hier gar nicht vorkommen, da diese Gräsergattungen im Gebiete fehlen. Wenn auf diesen Gräsern trotzdem aus Aecidien von *Rhamnus cathartica* die *P. coronifera* erhalten wurde, so sind die betreffenden Formen eben keine speziellen Formen, sondern gehören zu den am Orte vorkommenden, schon bekannten biologischen Formen. Uredosporen von *P. coronifera* auf *Avena sativa*, in obigen Versuchen aus Aecidiosporen von *Rh. cathartica* erhalten, infizieren 7. 6.—16. 6.: *Agropyrum repens* P. B., *Avena sativa* L., *Bromus inermis* Leyss., *Dactylis glomerata* L. (III), *Festuca distans* Kunth. (III), *Poa annua* L. und *Triticum vulgare* L. (III). Im Freien gesammelte Uredosporen auf *Avena sativa* L. ergaben *P. coronifera* 9. 6.—17. 6. auf: *Anthoxanthum odoratum* L., *Avena sativa* L. (III), *Bromus mollis* L., *B. secalinus* L., *Dactylis glomerata* L. (III), *Festuca distans* Kunth (III), *F. arundinacea* Schreb., *Hordeum vulgare* L. (III), *Melica ciliata* L. (III), *Phleum pratense* L. (III), *Poa annua* L., *Secale cereale* L. (III), *Triticum vulgare* L. (III). Im Freien gesammelte Uredosporen auf *Bromus inermis* Leyss. ergaben *P. coronifera* 28. 6.—7. 7. auf *Avena sativa* L. (2 Versuche), *Bromus inermis* Leyss., *B. mollis* L., *B. secalinus* L. und *Triticum vulgare* L. Im Freien gesammelte Uredosporen auf *Festuca elatior* L. ergaben *P. coronifera* 6. 6.—16. 6. auf: *Agropyrum repens* P. B., *Alopecurus nigricans* W., *Avena sativa* L., *Bromus secalinus* L. und *B. tectorum* L. Im Freien gesammelte Uredosporen auf *Festuca distans* Kunth. ergaben *P. coronifera* 10. 6. –18. 6. auf *Avena sativa* L. (2 Versuche). Im Freien gesammelte Uredosporen von *Calamagrostis epigeios* Roth. ergaben *P. coronifera* 10. 6.—20. 6. auf: *Agropyrum repens* P. B., *Avena sativa* L., *Bromus tectorum* L. und *B. secalinus* L. Die aus Aecidien von *Rhamnus cathartica* erhaltenen Uredosporen auf *Lolium temulentum* L. und *Sesleria coerulea* Ard. ergaben 27. 6.—5. 7. die *P. coronifera* auf *Alopecurus nigricans* W., *Lolium perenne* L. und *Phleum asperum* Vill., ferner am 29. 6.—8. 7. auf *Avena sativa* L. Auf Grund meiner Versuche bezweifle ich die Existenz von scharf voneinander geschiedenen biologischen Formen unter den mit Aecidium auf *R. cathartica* in Beziehung

stehenden Kronenrosten (mir fehlen Versuche mit f. sp. *Glyceriae*). Betrachtet man von diesem Standpunkte aus die Literaturangaben, so findet man, daß sie mit meinen Versuchen gut in Einklang stehen und nur bestätigt zu werden brauchten. So war bekannt die Übertragbarkeit: von f. sp. *Alopecuri*, f. sp. *Epigaei*, f. sp. *Lolii* auf *Avena sativa* L.; umgekehrt von f. sp. *Avenae* auf *Lolium perenne* L. (Jaczewski, Rostpilze der Getreidearten in Rußland, 1909 [russisch]), von f. sp. *Festucae* auf *Lolium perenne* L. und umgekehrt, von f. sp. *Avenae* (nach Carleton) auf *Holcus mollis* L., *Alopecurus alpestris* und *Festuca* sp., von f. sp. *Agropyri* auf *Lolium perenne* L. und *Festuca elatior* L. Manche neuere Autoren waren hingegen zu anderen Resultaten gekommen. Die Unsicherheit in den Resultaten der einzelnen Versuchsansteller erfordert zu ihrer Erklärung zunächst nicht die Annahme einer Spezialisation verschiedenen Grades für die einzelnen Länder. Sie wird schon durch die Übereinstimmung meiner und Carleton's Versuchsergebnisse unwahrscheinlich. Die f. sp. der *P. coronifera* Kleb. sind Gewohnheitsrassen, und soll eine solche in Infektionsversuchen nicht eine biologische Form (Art) vortäuschen, so muß vor allem für reichliche Aussaat gut keimender Sporen gesorgt werden. Während z. B. die am Orte *P. coronifera* führenden Gräser (*Avena*, *Agropyrum*, *Bromus*, *Calamagrostis* und *Festuca*) äußerst stark von den Aecidiosporen auf *R. cathartica* infiziert wurden (z. B. *Avena* mit 50—80 Uredolagern auf einem cm² der Blattfläche), wurden die anderen Gräser bedeutend schwächer befallen. Das Verhältnis der Zahl der Infektionsstellen bei den verschiedenen Gräsern einer Versuchsreihe kann sogar 100—1000 : 1 werden, und dann die Übertragbarkeit bei schwacher Aussaat leicht übersehen werden. Für eine Reihe von Carleton und mir nachgewiesener *P. coronifera*-Wirte zeigen unsere Versuche zugleich, daß auch hier keine biologischen Arten zu erwarten sind.

Zu bemerken ist, daß in meinen Versuchen mit Aecidien auf *Rh. cathartica* auch drei *P. coronata*-Wirte, nämlich *Agrostis stolonifera* L., *Calamagrostis arundinacea* Roth und *Phalaris arundinacea* L., infiziert wurden. Es bleiben auf diese Weise schließlich keine *P. coronata*-Wirte übrig, die nicht auch von *P. coronifera* befallen werden. Andererseits konnte ich durch in Livland angestellte Versuche nachweisen, daß *P. coronata* auf zwei *P. coronifera*-Wirte übergeht. Aecidiosporen von *R. frangula* infizierten (8. 7.—19. 7.) *Agrostis alba* L. und zugleich *Calamagrostis epigeios* Roth (III) und *Poa pratensis* L. Am Fundorte der Aecidien, einer gut isolierten Waldwiese, war deutlich zu beobachten, wie die *P. coronata* diese drei zwischen den *R. frangula*-Sträuchern stehenden Gräser infizierte, also auch in der Natur auf sie übergeht. Aecidien auf *R. frangula* von einem anderen Fundorte kommend, wo sich gleichfalls *Calamagrostis epigeios* befand, infizierten wiederum *Calamagrostis epigeios* (15. 7.—24. 7., III). Nach Mühlethaler infizieren Aecidiosporen von *R. frangula Anthoxanthum odoratum* L., welches nach Carleton's und meinen Versuchen zugleich *P. coronifera*-Wirt ist.

Sollten auch *P. coronata* (Corda) Kleb. und *P. coronifera* Kleb. keine streng geschiedene Arten sein?

28. Aus Rabenhorst's Kryptogamenflora und Lindau, Hilfsbuch f. d. Sammeln paras. Pilze, entnehme ich die Angabe, daß *Uromyces Polygoni* (Pers.) auch auf *Rumex acetosella* L. vorkommt. In meinen Versuchen infizierten Uredosporen von *U. Polygoni* auf *Polygonum aviculare* L. nur diese Pflanze, nicht aber *Rumex acetosella*.

29. *Uromyces* auf *Caragana*-Arten wird meist zu *Uromyces Genistae-tinctoriae* (Pers.) auf *Cytisus*- und *Genista*-Arten gestellt. Ich verfügte über reichliche Mengen gut keimender Aecidiosporen von *Euphorbia virgata* W. K., das von demselben Fundorte, wie das zur Infektion von *Caragana frutescens* DC. (s. Infektionsversuche I, No. 5) benutzte Sporenmaterial, stammte. Da nach Aussaat dieser Sporen *Caragana arborescens* L. sehr stark infiziert wurde (4. 5.—16. 5.), nicht aber *Cytisus capitatus* Jacq., *C. biflorus* L'Hérit. (2 Versuche), *C. nigricans* L. (2 Versuche), *Galega officinalis* L. (3 Versuche), außerdem *Trifolium agrarium* L. (2 Versuche) und *Lotus corniculatus* L., so glaube ich, daß es sich beim *Uromyces* auf *Caragana*-Arten um eine von *Uromyces Genistae-tinctoriae* abzutrennende biologische Form handelt. Damit in Einklang stehen erfolglose Versuche, *Cytisus alpinus* Mill., *C. laburnum* L., *Genista germanica* L. und *G. tinctoria* mit Uredosporen von *Caragana arborescens* zu infizieren, die ich vor Jahren anstellte. In Infektionsversuche I, No. 5, habe ich diese Versuche nicht angeführt, weil sie mit im Garten stehenden Pflanzen angestellt wurden und für sich allein nicht genügend beweiskräftig schienen. Jetzt habe ich die Versuche im Warmhause mit Uredosporen von *Caragana frutescens* DC. mit demselben Resultate wiederholt: *Cytisus biflorus* L'Hérit. (3 Versuche), *C. capitatus* Jacq., *C. laburnum* L., *C. nigricans* L. (3 Versuche) und *Colutea arborescens* L. blieben pilzfrei, während auf *Caragana arborescens* (2 Versuche) und *C. frutescens* (2 Versuche) zahlreiche Uredolager (zu 10—20 auf einem Fiederblättchen) auftraten.

30. In Ergänzung des Versuches No. 6, Infektionsversuche I, infizierte ich mit Aecidiosporen von einer einzigen *Euphorbia virgata*-Pflanze gleichzeitig *Medicago minima* Bart., *M. murex* Willd. und *Trifolium arvense* L. Dies weist darauf hin, daß die Zusammenfassung der in Frage kommenden *Uromyces*-Formen auf *Medicago* und *Trifolium* als *U. striatus* Schroet. das Richtige trifft. Es ist wenig wahrscheinlich, daß die zum Versuch verwendete *Euphorbia*-Pflanze gleichzeitig zwei biologische Arten führte, besonders wenn man berücksichtigt, daß der Pilz auf *Trifolium*-Arten aus Mangel an Wirtspflanzen hier nicht vorkommt. *Ononis hircina* Jacq. blieb in diesem Versuche pilzfrei.

31. Die Versuche mit Aecidium auf *Euphorbia virgata* W. K. und *Uromyces Astragali* (Opiz) wiederholend (s. Infektionsversuche I, No. 4), infizierte ich mit den Aecidiosporen reichlich *Astragalus creticus* Lam. und *A. sanguinolentus* M. B. Auf *Galega officinalis* L., welche gleichfalls als

Wirtspflanze von *Uromyces Astragali* gilt, ging der Pilz nicht über, auch nicht auf *Ononis hircina* Jacq.

32. Es ist schon von Tranzschel darauf hingewiesen worden, daß *Uromyces caryophyllinus* (Schrank) sein Aecidium auf *Euphorbia Gerardiana* Jacq. haben dürfte. Bei Charkow habe ich schon vor Jahren Gelegenheit gehabt, in der Natur den Zusammenhang der Aecidien auf *E. Gerardiana* mit *U. caryophyllinus* auf *Dianthus campestris* M. B. zu beobachten. Hier fand ich *U. caryophyllinus* auf einem für diesen Pilz neuen Wirte, *Dianthus pseudarmeria* M. B. Die überwinterten, gut keimenden Teleutosporen von *D. pseudarmeria* säte ich auf *Euphorbia Gerardiana* Jacq., *E. glareosa* M. B., *E. platyphyllos* L. und *E. virgata* W. K. aus. Der Versuch mit *Euphorbia Gerardiana* führte zu keinem Resultate, da die Pflanzen nach einer Woche eingingen; die übrigen Arten blieben pilzfrei. Dagegen gelang sehr gut die Übertragung mittels Aecidiosporen von *E. Gerardiana*, welche am Fundorte des *U. caryophyllinus* auf *D. pseudarmeria* gesammelt worden waren. Die mit großen Mengen gut keimender Aecidiosporen bestäubten Pflanzen von *Dianthus arenarius* L. (2 Versuche), *D. campestris* M. B., *D. capitatus* DC., *D. caryophyllus* und *D. pseudarmeria* M. B. zeigten am 13.—15. Tage zahlreiche Uredolager, später auch Teleutosporen. Die im Freien gesammelten Teleutosporen des Pilzes auf *D. pseudarmeria* keimen schon im Herbste sehr gut.

33. Die Aussaat der Aecidiosporen von *Euphorbia Gerardiana*-Pflanzen, welche in der Natur zwischen *Silene otites* Sm. wuchsen, ergab auf *Silene otites* reichliche Bildung von Uredo- und Teleutosporen des *Uromyces Schroeteri* de Toni.

Nowotscherkask, Botan. Lab. d. Polytechnikums.

The life history of Ascochyta on some leguminous Plants [1]).

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(With Plates XIX—XX.)

The genus *Ascochyta* comprises about 250 species (18) most of which are typically leafspot forming fungi, although they may appear on other parts of their host plants. Of these species at least 10 have been described as occuring on herbaceous legumes. Most of these species have been described from Europe and America.

Ascochyta pisi Lib. is the most widely known of these species and has been reported on the widest range of host plants. It has been said to occur on three widely separate tribes in the Papilionaceae (45).

The fungus is widely distributed in Europe. In North America it is common throughout the United States east of the Mississippi River and in eastern Canada. West of the Mississippi River it has attracted little attention except in Nebraska and in the Pacific coast states.

In respect to its parasitism a considerable amount of knowledge has been gained concerning the "pea blight" organism. Various workers have shown that the fungus may be carried over from one crop to the next by means of the seed. The fungus mycelium enters the seed coat and remains dormant until the seed begins to germinate, when the fungus developes its pycnidia and spores thus infecting the seedling from which it spreads the disease to other seedlings nearby (23, 25, 27, 45).

It is also generally known that if peas are grown continuously on the same soil the „pea blight" gains in severity. In some cases even the second crop may be too poor to pay the expense of harvesting (45). This would seem to show that there must be some other method of tiding the fungus over from season to season.

In 1909 Professor George F. Atkinson (2) demonstrated that the *Ascochyta* occuring on *Vicia villosa*, in this region, has as its perfect stage, a *Mycosphaerella*, found on the old, dead stems and pods of the same plant. This discovery gave rise to the hope that the perfect stage of other species of *Ascochyta* on legumes might be found.

[1]) Contribution from the Department of Botany, Cornell University no. 151.

At his suggestion, therefore, I have taken up the study of these species of *Ascochyta* in this region with a view of finding out more concerning their life history and of throwing some light on their interrelations.

Herbarium specimens, tube cultures, and microscope mounts have been deposited in the Botanical Department of Cornell University where the work was done.

My acknowledgements are due to Professor Atkinson, at whose suggestion the work was taken up; and to whom I am indebted for advise and assistance throughout the investigation; and also to Doctor W. G. Farlow, Doctor N. L. Britton and Mrs. Flora Patterson for material from their herbaria and to many others who have helped me in various ways.

The life history of Ascochyta pisi Lib.

Ascochyta pisi Lib. may appear at any time in the life of its host from the seedling stage until its maturity and may persist for a considerable time on the dead stems and pods. It may also remain in the seed coats in the form of dormant mycelium until the seed germinates when it forms pycnidia, and spores.

The imperfect or pycnidial stage of the fungus causes a disease of the pea resembling, in many respects, the anthracnose of the bean. When it attacks seedlings it causes deep, brown lesions to form on the stems, on which the pycnidia may be seen as small brown points. On the green stems of larger plants the same appearance may be noted. On the leaves it causes circular, brown spots several millimeters in diameter, or the spots may become white in the center with a brown margin. The spots are sometimes vague and not well defined. The appearance of the disease varies greatly according to the age of the pod when infection takes place. If infection occurs when the pod is young and succulent deep pits may be produced which have the general appearance of spots on the bean pods due to the anthracnose. If the fruit is near maturity at the time of infection no definite spot is produced and only the small, brown pycnidia appear on the yellowish white tissue of the pod. This same appearance is presented on dry and mature stems and leaf petioles.

The pycnidia are small, brown globose structures from one tenth to two tenths millimeters in diameter. About two thirds of the pycnidium is sunken down in the tissue of its host and the other third, containing the ostiole, projects above the surface.

The spores are hyaline, oblong and obtuse at each end. When young the spores are continuous and have two oil drops but when mature the spores are usually once septate and the spore-content is uniform. The spores are surrounded by a very small amount of gelatinous substance and when a pycnidium is immersed in water the spores ooze out in long tendrils. When seen in mass the spores are pink to flesh color.

The spores germinate very readily in water from ten to twelve hours. In the process of germination the spore first takes up water and increases in size until it is about twice its normal diameter, but it does not increase very much in length. The cells become distended and more or less globose so that the spore becomes very deeply constricted at the septum. In some cases the two cells may become separated.

By this time the cell contents has become vacuolate with one large, central vacuole. Germ tubes are put out from one or both cells, either simultaneously or in succession. The germ tubes grow rapidly and may attain a length of 160 microns in twenty four hours. At first the germ tubes are continuous but after a length of 300—400 microns has been reached septa are laid down, first near the spore and then following up the growth. Except where growth is very slow or has been checked cross walls are seldom seen nearer the apex than 120 microns. At length the mycelium becomes slightly constricted at the septa.

After the first germ tube has reached a considerable length the same cell may form two or even more secondary germ tubes, to that a single spore may give rise to six or more germ tubes. These are at first without branches but after 24—36 hours branches begin to appear until the interlacing mycelium forms a colony with a fine mesh. Branches were never observed until after cross walls were laid down.

When germinating in water adjoining hyphae very frequently anastomose. Sometimes a germ tube may connect one spore directly with another spore. Jarius (25) in his study of *Ascochyta pisi* as a parasite and as a saphrophyte has also noted this anastomosing of the hyphae.

The fungus grows readily in nutrient media and the details of germination are essentially the same as in water. In acid bean pod agar it produces mycelium visible to the eye in about 60 hours. The colony enlarges rapidly and by the end of four days it may be a centimeter in diameter and indications of pycnidia may be seen as tiny brown spots in the colony. The pycnidia mature in about six days depending to some extent on the temperature at which the culture is kept, but six days is the usual time at room temperature. The most rapid growth takes place at about 25° C.

Both above and below this temperature the rate of growth is retarded. At 33° C the growth was inhibited and at 37° C the fungus was killed. Six sets of six plates were used in this experiment with the thermostat. These results would seem to be somewhat unusual and it may be that my material was not in the proper condition.

Growing in bean pod agar the colony is very slightly tinged with brown, but the hyphae, seen singly, appear hyaline. The pycnidia produced are normal in every way as are also the spores which they produce.

In bean pod agar to which 20% cane sugar has been added growth is very luxuriant with a large amount of aerial mycelium so that the colony becomes almost hemispherical. The mycelium is olive green and the individual hyphae are much larger und coarser than when in plain bean pod agar. The colonies are dark olive green, with a hyaline border and white and floccose on top. Pycnidia are slower to develop and do not appear before the seventh day but they then become very numerous and are darker than in bean pod agar. Under ordinary laboratory conditions they appear in zones, giving the colony a zonate or concentrically banded appearance.

In beef-extract peptone agar growth is slower than in plain bean pod agar with somewhat more aerial mycelium which gives the colony a floccose appearance. The colony is very slightly tinged with brown and the hyphae are the same as in plain bean pod agar. The pycnidia are numerous and scattered as on bean pod agar but are slower in making their appearance, not being seen before the sixth day.

On potato agar the growth is slow and the colony very dense, dark green or bluish green in color, with a distinct lighter border. Pycnidia are less numerous than in the three media preceeding and do not develop before the seventh day.

On prune juice agar the growth is similiar to that on bean pod agar to which 20% cane sugar has been added.

The fungus also grows readily on sterilized bean pods where it produces little aerial mycelium. The substratum soon becomes light brown due to numerous pycnidia. The fungus spreads and finally covers all of its substratum. Spores are produced in great abundance and ooze out of the pycnidia forming pinkish masses. The same appearance may be noted on pea pod spots when the weather is very damp and there has been no rain to wash the spores away. In this condition it has a superficial appearance very much like a *Gloeosporium*.

On sterilized *Melilotus* stems the growth is similiar to the growth on bean pods but lese vigorous and fewer pycnidia are developed.

On squash stems the growth is more vigorous than on *Melilotus* stems but less vigorous than on bean pods.

On potato slices the growth resembles the growth on potato agar with the same peculiar bluish green color, and few pycnidia.

In corn meal moistened and sterilized in flasks, the fungus grows readily, finally turning the medium a light brown. The pycnidia develop in very large numbers. The culture may retain its vigor for six months without transferring if the medium is not allowed to dry out.

Sphaerella pinodes (Berk. and Blox.) Niessl.

In the autumn of 1910 I collected a *Sphaerella* on the stems and pods of the garden pea, which had previously been attacked by *Ascochyta pisi*.

Dr. Rehm, from material sent to him, has confirmed my identification of this as *Sphaerella pinodes* (Berk. and Blox.) Niessl.

This *Sphaerella* appears as small, brown, punctate dots on the surface of the mature stems and pods of the garden pea. I have not yet found it on the leaves. In the vertical section the perithecia are seen to be globose with a central papilliform or beaklike ostiolum. The perithecia are sunken to different depths in the cortex, some are just below the epidermis while others develop between the cortex and stele. Hence the ostiolum varies in length as it connects the perithecium with the surface and projects only a short distance above the epidermis.

The asci arise from the base of the perithecium in clusters as is usual in the genus *Sphaerella*. The asci are cylindrical clavate in form. The walls are thin except at the apex where they are thickened. In the center of this thickening is a thin place or pore. This pore is not, however, provided with the highly refractive ring as described and figured for the genus *Gnomonia* by Klebahn (26) and by Edgerton (15—16). In *Gnomonia* the pore is so characteristic that it is often used as a diagnostic character.

The ascus wall in *Sphaerella pinodes* is made up of two membranes and it is the inner membrane which is thickened at the apex and in which the pore is found. The formation of a pore in the apex of the ascus is a common characteristic among many Pyrenomycetes. In the genus *Sphaerella*, however, little attention has been given to this feature. In illustrations of species of this genus the ascus is often shown with thin side walls and a thickened apex but few illustrations show the pore. The structure is shown in *Sphaerella Ulmi* by Klebahn (26), in *Sphaerella opuntiae* by Wolf (47) and in *Sphaerella nerviseda* and *Sphaerella coneglanensis* by Saccardo (36). In examining material to ascertain if this character is at all common in the genus I have found the pore to be present in the following cases:

Sphaerella balsamorrhizae, *S. baptisicola*, *S. citrullina*, *S. dendromeconis*, *S. iridis*, *S. Linhartiana*, *S. maculiformis*, *S. lithospermi*, *S. oenotheri*, *S. paraolata*, *S. petalostemonis*, *S. phlogina*, *S. thalictri*, *S. Tassiana*, *S. vagans* and *S. vagneriae*.

That the genus is far from being uniform in this respect is shown by the fact that the pore is not present in the following cases, or at least I could not demonstrate it in the material examined.

Sphaerella arbuticola, *S. coerulea*, *S. colorata*, *S. coptis*, *S. delphinicola*, *S. Fendleri*, *S. Earliana*, *S. granulata*, *S. gossypina*, *S. glycosomae*, *S. monardiae*, *S. muhlenbergiae*, *S. paludosa*, *S. punctiformis* and *S. sentina*.

Ejection of the spores.

At maturity the contents of the ascus may absorb water and the resulting pressure tends to increase its size. The outer membrane of the

ascus being inelastic, is ruptured, the rupture taking place at the apex. The inner, elastic membrane then slowly stretches until the extended ascus is approximately three times as long as the normal ascus. There is little increase in diameter of the structure formed by the elongated inner membrane. The whole structure remains about the same diameter as the outer membrane which forms a sheath at the base and is not changed in any way.

While the inner membrane is stretching out the spores are crowded upward towards its tip so that the uppermost spore remains in contact with the membrane.

The spores retain the order occupied by them in the normal ascus, that is they remain in a single series, and with little interval between them.

This process of elongation takes place in about five minutes. Toward the last the movement is so slow that only by comparing an ascus with the marks on the eye piece micrometer can the motion be detected.

Finally the membrane ruptures at the apex where it has been weakened by the pore. The spores are thrown out in a continous series without any appreciable interval between the spores. After the spores have been ejected the stretched membrane contracts about a third of its length and then appears very limp and flaccid. Sometimes only six of the spores will be ejected in the manner described above and then there is a second elongation and the two remaining spores are discharged. The spores when ejected are thrown in a direction parallel to the axis of the ascus.

I have seen the asci eject their spores only in water under a cover glass and I have no idea how far they may be thrown under normal conditions. Under the conditions I have mentioned the spores are thrown a distance of 100 microns.

In this continuous discharge of the spores *Sphaerella pinodes* behaves differently from *Sphaerella scirpi*, as described by Pringsheim (31) and by de Bary (14), and from *Sphaeria lemaneae* as described by Woronin (48) where the spores are ejected in succession with an appreciable interval between discharges. This successive discharge is common among the Pyrenomycetes, de Bary cites, in addition to *Sphaeria scirpi*, *Pleospora herbarum*, *Sphaeria lemaneae*[1]) and others. In the genus *Guignardia*, Reddick (32, 33) has described the discharge of spores as occuring in succession and says that it takes about 10 minutes for the entire discharge to take place. One would expect a somewhat closer resemblance in the method of spore discharge in genera as closely related as *Guignardia* and *Sphaerella*. *Guignardia Bidwellii* however, has no pore in its ascus wall (33) as has *Sphaerella pinodes*.

[1]) *Sphaeria lemaneae* Cohn = *Leptosphaeria lemaneae* Sacc.

But in other genera where the pore is present there occurs the same successive ejection as shown by Frank in *Gnomonia erythrostoma* (21).

In structure the ascus resembles to some extent the asci of *Sphaeria herbarum* and *Sphaeria spartii*[1]). I have not observed a cap lifted off the apex of the outer membrane as described by Curry (13) for *Sphaeria herbarum*.

Neither have I been able to detect a gelatinization of the inner membrane as described for *Sphaeria scirpi* by Pringsheim (31). De Bary (14) also mentions this gelatinization of the inner membrane and says that it takes place in may cases. He doubts, however, whether the mechanism of the spore ejection in the *Sphaeria* has been observed under anything like normal conditions except for *Sphaeria scirpi* and *Sphaeria lemaneae*. Certainly the isolated asci of *Sphaerella pinodes* which I have seen eject their spores were not functioning under normal conditions.

It is probable that in the perithecium the asci elongate into the ostiolum and their apices may reach its outer end before spore discharge takes place. The length of the elongated ascus is about sufficient to reach from the base of the perithecium to the apex of the ostiolum.

The spores are eight in number and are hyaline, ellipticalovate, two-celled and constricted at the septum. The upper cell is slightly larger and more rounded than the lower cell. When young the spores are more or less acute, sligthly curved and in each cell are two oil drops. As the spore matures it takes on the form first described, the oil drops disappear and the spore contents becomes uniform.

Germination of the Ascospores.

Ascospores mature enough to germinate may be collected as early as August 19, and can then be found until the middle of the following June. I have found the ascospore material most abundant in October and November. The specimens from European collections, which I have seen were collected in September and October.

The ascospores germinate readily in water and in nutrient media. Germination takes place in about twelve hours, although some of the spores may delay germination for 24 hours or even longer.

Growth takes place rapidly, especially in nutrient media, so that a colony a millimeter in diameter may be formed in 60 hours. In four days evidences of pycnidia in the colony may be seen as tiny, brown points on the mycelium. Pycnidia of the *Ascochyta* type are mature in six days when the colony is growing in bean pod agar.

The details of ascospore germination are essentially like those described for the *Ascochyta* spores except that the ascospores do not increase

[1]) *Sphaeria spartii* (Nees) = *Cucurbitaria spartii* (Nees) Winter.

in size as much as do the pycnospores. In many cases the ascospores will germinate before their entire outline can be made out in the ascus. In the germination of an immature ascospore the oil globules first disappear and then, as in the mature spores the cells increase in size, by absorbing water, and the content becomes vacuolate with one large central vacuole.

Both cells may germinate at the same time or the process may be delayed for some time in the lower cell and occasionally only one cell germinates. After the first germ tube, which is usually terminal, has reached a length of 150 or 200 microns the cell may give rise to two or more secondary germ tubes like the first, but lateral instead of terminal.

The hyphae are at first neither branched nor septate but after 36 hours septa are laid down in the oldest parts of a hyphae and then branches begin to appear. The colony, when first visible, appears as a group of very fine, white lines radiating from a central point.

Connection of Ascochyta Pisi Lib. and Sphaerella pinodes (Berk. and Blox.) Niessl.

I have always found *Sphaerella pinodes* on pea plants that had previously been attacked by *Ascochyta pisi*. In all cases when examination has been made early in the autumn the mounts made from the material bearing ascospores have shown conidia mixed with them and in many cases predominating in numbers. Careful examination of such material will show the pycnidia and perithecia intermingled. In sectioning such material often both types of fruit bodies may be found on the same section. In Europe the two types of fructification often occur together as may be seen by an examination of number 1426 of Krieger's Fungi Saxoni.

If dilution cultures are made from material of this type pure cultures of *Ascochyta* can be obtained although both ascospores and pycnospores germinate with equal readiness.

If a dilution plate be carefully examined before germination starts the ascospores may be readily distinguished and their position marked. The development may be watched in situ or the spore, with a small amount of the surrounding agar may be cut out and transferred to another plate and allowed to grow, without danger of the colony being contaminated by colonies from other spores.

Or, if a mature perithecium be crushed on a slide, individual ascospores may be taken from the slide, by means of a sterile needle, and planted directly in agar. All three of these methods have been used for isolating ascospores. The last method is perhaps the best.

In all cases where an ascospore germinated and formed a mature colony, the fungus produced pycnidia of the *Ascochyta* type. These colonies agreed in all morphological and cultural characters with colonies of *Ascochyta pisi* grown directly from the pycnospores. The following table

will show the results of this work and the number of trials made. In each case the ascospores were obtained from the *Sphaerella pinodes* on the pea.

Material collected in October, put out in wire baskets and brought in for each test.

Date	How Isolated	No. of Spores	Result	Date
Nov. 21, 1910	Marked	12	12 *Ascochyta*	Nov. 28, 1910
Jan. 1, 1911	Marked	15	15 *Ascochyta*	Jan. 9, 1911
Jan. 21, 1911	Marked	10	10 *Ascochyta*	Jan. 30, 1911
Feb. 3, 1911	Marked	12	12 *Ascochyta*	Feb. 10, 1911
Feb. 17, 1911	Marked	10	Failed to grow	
Feb. 17, 1911	Marked	9	1 Colony (Ascochyta)	
Feb. 25, 1911	Transplanted	7	7 *Ascochyta*	Feb. 8, 1911
April 22, 1911	Transplanted	10	10 *Ascochyta*	May 1, 1911
May 18, 1911	Transplanted	10	10 *Ascochyta*	May 25, 1911

Material collected in September, kept outdoors and brought in as needed.

Date	How Isolated	No. of Spores	Result	Date
Sept. 15, 1911	Transplanted	14	14 *Ascochyta*	Sept. 23, 1911
Oct. 20, 1911	Transplanted	14	7 *Ascochyta*	Oct. 29, 1911
Jan. 14, 1912	Transplanted	11	11 *Ascochyta*	Jan. 23, 1912
Jan. 30, 1912	Planted directly	5	5 *Ascochyta*	Feb. 8, 1912
Febr. 26, 1912	Planted directly	10	10 *Ascochyta*	Mar. 6, 1912
Apr. 4, 1912	Planted directly	8	8 *Ascochyta*	Apr. 12, 1912
June 16, 1912	Planted directly	7	7 *Ascochyta*	June 24, 1912

For the trial made February, 17, 1911 no results were obtained but as no colonies of any fungus developed in the poured plates from which the spores were taken I concluded that the agar was too hot when the plates were poured. In the trial made October, 20, 1911 one of the plates to which the spores were transplanted became contaminated with *Rhizopus* and although colonies resembling *Ascochyta pisi* started to grow they never matured. In the planting made January, 26, 1912 two of the spores failed to germinate.

With these exceptions the planted ascospores gave rise to colonies of *Ascochyta*.

Inoculation work.

Only three trials were made in my inoculation work to infect *Pisum sativum* directly with ascospores of *Sphaerella*. The *Ascochyta* persists on

the old stems and it is impossible to be entirely sure that no conidia are present in the material placed on the trial host.

June, 18, 1912, three pea plants which had been grown from perfect seed, were inoculated with ascospore material known to contain viable ascospores and taken from old pea vines on which very little *Ascochyta* remained. Perithecia were crushed out on a slide and then the drops of water containing the ascospores were placed on one of the leaves of the pea plant. Several leaves on each of the three plants used were treated in this way. The plants were then placed under bell jars for 48 hours so that the surface of the plants would remain damp.

All of the plants thus treated developed typical lesions on the stems at the leaf bases and also typical *Ascochyta* leaf spots. The lesions began to show as discolored spots on the fifth day from the time of inoculation and the first pycnidia were seen at the end of ten days.

Inoculation with pure cultures.

The ascospores planted April, 2, 1912 were used as a basis for stock cultures from which material was obtained for inoculation with pure cultures. The *Ascochyta* resulting from these ascospores were transferred to bean pods for propagation until several tubes of pure culture were available for use.

Peas grown from seed free from *Ascochyta* were planted in soil free from the blight organism and guarded from contamination. At the time of inoculation the plants were first sprayed with water, then small bits of the *Ascochyta* cultures were placed on the stems and leaves. The pots containing the seedlings were then covered with bell jars and kept moist for 48 hours. The bell jars were then removed and the plants allowed to grow under normal conditions.

Within five days discolorations began to appear, especially on the stems of the inoculated plants, which rapidly developed into *Ascochyta* lesions. Pycnidia of *Ascochyta* were seen within three days but isolations were postponed until about two weeks.

The following table gives the results of these inoculations with pure culture.

Material	Trial Host	Date	Result	Reisolated
1 *Ascochyta*	Pea	Apr. 26, 1911	*Ascochyta*	May 12, 1911
2 *Ascochyta*	Pea	Apr. 26, 1911	*Ascochyta*	May 12, 1911
3 *Ascochyta*	Pea	Apr. 26, 1911	*Ascochyta*	May 12, 1911
4 *Ascochyta*	Pea	May 20, 1911	*Ascochyta*	June 1, 1911
5 *Ascochyta*	Pea	May 20, 1911	*Ascochyta*	June 2, 1911
6 *Ascochyta*	Pea	June 2, 1911	*Ascochyta*	June 14, 1911
7 *Ascochyta*	Pea	June 4, 1911	*Ascochyta*	
8 *Ascochyta*	Pea	June 4, 1911	*Ascochyta*	

It is thus seen that the *Ascochyta* derived from the ascospores readily infects pea plants and produces the typical disease from which the organism can be again isolated.

The *Ascochyta* grown from ascospores and also the *Ascochyta* derived directly from diseased pea plants have been grown on a variety of media but no perfect stage has been produced in culture.

The following media have been used. Bean pod agar, prune juice agar, potato agar, oat agar, Melilotus stem agar, bean pod agar to which 20% of cane sugar was added, bean pods, squash stems, *Melilotus* stems, potato tubes and corn meal.

Cultures derived from different sources have been grown together without any indication of plus and minus strains. The fungus has also been grown at different temperatures ranging fron 15° C to 35° C without producing the perfect stage.

Conclusions.

Sphaerella pinodes (Berk. and Blox.) Niessl, is the perfect stage of *Ascochyta pisi* Lib. The evidence for this may be summarised as follows.

1st. The two fungi are very often found intimately associated, the *Sphaerella pinodes* often accompanying or following the *Ascochyta*.

2nd. Ascospores germinated in nutrient media produce an *Ascochyta* agreeing in all particulars with cultures derived from *Ascochyta pisi* Lib.

3rd. *Ascochyta* in pure culture derived from the ascospores is capable of infecting the pea plant and producing typical lesions from which the *Ascochyta* may be reisolated.

4th. Ascospores may infect the pea plant producing the typical *Ascochyta* disease.

Ascochyta on Vicia villosa.

Ascochyta viciae Lib. was originally described from material occurring on *Vicia sepium* in Europe. Other species of *Ascochyta* with very similar morphological characters have been described on other species of *Vicia*. Also the name *Ascochyta pisi* Lib. has been widely used for this and similar fungi. The name *Ascochyta viciae* Lib. is often applied to the *Ascochyta* on *Vicia villosa*. Clinton (9) considered the fungus on Russian vetch as distinct from *Ascochyta pisi* Lib. and applies the name *Ascochyta viciae* Lib. as is also done in some of the exsiccati. In Saccardo Syll. Fung. *Vicia villosa* is reported as a host for *Ascochyta pisi*. Van Hook (45) reports Ducomet as authority for this usage. There is then some confusion in the name applied to this species.

The fungus appears on the stems, leaves and pods of the hairy vetch. On the stems it causes lesions or sunken, discolored areas more or less elongated. On the leaves the spots are usually circular and vary in size from 1 to 3 millimeters in diameter. The spot may be entirely brown

or have a white center and a brown border. On the pod the appearance is also variable. On young green pods the spots are first brown and then become sunken, with a white center bearing numerous, brown pycnidia, and with a brown margin. The spots are usually circular, 2 to 3 millimeters in diameter but some times becoming confluent and making irregular spots. On older, mature pods no spot at all may be produced. Then the brown pycnidia may be seen as tiny brown points scattered over the grey tissue of the pod. This same appearance may also be seen on mature stems.

The pycnidia are of the same type as found in *Ascochyta pisi* and bear spores similar in all respects to the spores of the fungus.

The pycnospores germinate readily in water and in nutrient media. With mature spores germination may take place in 10 hours or it may be delayed so that at the end of 24 hours spores in all stages of germination may be found in the same mount or culture.

When young the spores are non septate and guttulate. At maturity the spore becomes septate and the guttulae disappear. Upon germinating the spore increases in diameter and the cells become inflated so that each cell tends to become globose. As a result the spore becomes strongly constricted at the septum and the two cells may even separate. At this stage a large vacuole has formed in each cell. Each cell is capable of giving rise to three or four germ tubes.

In nutrient media growth takes place rapidly so that on the third day the colonies are visible as fine white lines radiating from a central point. The colony enlarges rapidly and if not crowded may reach a diameter of an inch or more in 7 days, on bean pod agar.

When not crowded pycnidia are slow to appear but if the colonies are crowded pycnidia may appear on the fifth day. On bean pod agar there is little aerial mycelium and the colony is only slightly tinged with brown.

On this medium and also on bean pod agar 20% cane sugar, beef extract-peptone agar, potato agar, bean pods, Melilotus stems ect. the growth is exactly the same as that of *Ascochyta* from the pea.

Sphaerella viciae Schroeter.

Schroeter has described a *Sphaerella viciae* on stems of *Vicia cracca* from Norway. A fungus agreeing with Schroeter's description has been collected here a number of times, both by Professor Atkinson and myself, on stems an pods of *Vicia villosa*. From material sent to Dr. Rehm this determination has been confirmed.

The fungus is seen best on mature pods where it forms prominent, dark brown dots on the grey substratum. A vertical section through a perithecium shows it to be globose with a prominent beak-like ostiolum. If material is gathered in the autumn the sections show that the perithecia are deeply sunken in the cortex and the beak extends but a very short

distance above the surface of the substratum. This is seen very well especially on the stems. Material gathered later in the year, as in the following spring, shows that the cortical tissue of the host has been weathered away and then the ostiolum projects very strongly, many times, and gives the perithecium the appearance of a *Gnomonia*.

The asci are cylindrical to cylindrical-clavate, somewhat curved and arise from the base of the perithecium in clusters. The ascus wall is thin but thickened at the apex with a pore in the inner membrane.

The spores are two celled with the upper cell slightly larger making the spore obovate. When young the spores are guttulate but at maturity the cell content is uniform.

The spores are ejected, as has already been described for *Sphaerella pinodes*, by the rupture of the outer membrane at its apex and the elongation of the inner, elastic membrane until the ascus is three times its normal length. The spores are crowded into the apex of the ascus and when it ruptures at the weak point formed by the pore they are thrown out in a group.

The spores germinate readily in water or nutrient media and form colonies visible to the eye on the third day. The details of germination differ in no way from the process already described for *Sphaerella pinodes*.

Mature perithecia have been collected as early as August 12 and ascospores may be found as late as June.

Connection of the Ascochyta and Sphaerella viciae.

In early August when the perithecia first begin to form I have always found the *Ascochyta* and *Sphaerella* intermingled and I have never found the *Sphaerella* on plants that had not previously been attacked by the *Ascochyta*.

In May 1909, Professor Atkinson made a study of this *Sphaerella* and found that the ascospores planted in nutrient agar germinated and produced colonies of *Ascochyta*. Ascospore material placed on *Vicia villosa* seedlings produced the typical leaf spots and also seedlings were infected with a pure culture of *Ascochyta* derived from ascospores (2).

In my own work I have verified these results. The number of ascospores planted which developed *Ascochyta* colonies throughly confirms his work.

Material	Number of Spores	Date	Result	Date
Sphaerella viciae	10	Aug. 20, 1911	9 *Ascochyta*	Aug. 27, 1911
Sphaerella viciae	11	Sept. 1, 1911	11 *Ascochyta*	Sept. 7, 1911
Sphaerella viciae	10	Aug. 21, 1911	10 *Ascochyta*	Aug. 27, 1911
Sphaerella viciae	15	Nov. 28, 1911	15 *Ascochyta*	Dec. 6, 1911
Sphaerella viciae	9	Feb. 17, 1912	9 *Ascochyta*	Feb. 23, 1912
Sphaerella viciae	6	Feb. 26, 1912	4 *Ascochyta*	Mar. 5, 1912
Sphaerella viciae	8	Apr. 12, 1912	8 *Ascochyta*	Apr. 18, 1912
Sphaerella viciae	6	June 16, 1912	4 *Ascochyta*	Marked on slide

Pure cultures of the *Ascochyta* derived from the ascospores planted April 12, 1912 were used for inoculation work both in infecting Vetch and pea plants.

Source of Material	Trial Host	Date	Result	Date
Sphaerella viciae	*Vicia villosa*	June 4, 1912	*Ascochyta*	June 18, 1912
Sphaerella viciae	*Vicia villosa*	June 4, 1912	*Ascochyta*	June 16, 1912
Sphaerella viciae	*Vicia villosa*	June 18, 1912	Negative	
Sphaerella viciae	*Vicia villosa*	June 18, 1912	*Ascochyta*	June 30, 1912
Sphaerella viciae	*Vicia villosa*	June 24, 1912	*Ascochyta*	July 3, 1912

I did not attempt to inoculate *Vicia villosa* directly with ascospores as in my material there were too many other fungi present. Ascospores were not numerous so that at times a number of slides had to be prepared before any ascospores were obtained.

The fungus has been grown on the following media but without production of the perfect stage.

Bean pod agar, prune juice agar, bean pod agar plus 20% cane sugar, potaro agar, oat agar, bean pods, *Melilotus* stems, squash stems, potato tubes and corn meal.

We are, however, justified in considering the *Sphaerella viciae* as the perfect of the *Ascochyta* occuring on *Vicia villosa.*

Identity of Sphaerella pinodes and Sphaerella viciae.

Dr. Rehm, in private correspondence, has informed me that *Sphaerella viciae* is often considered a synonym of *Sphaerella pinodes* by European mycologists.

The two fungi resemble each other very closely, to say the least, in morphological and cultural characters.

Their perithecia have the same form and structure and are developed at the same time of year. Their asci are the same size form and structure and have the same method of dehiscence. Their ascospores are identical. Both are connected with *Ascochyta* as their pycnidial form and the morphological characters of pycnidia and pycnospores are the same. In cultures they behave similarly.

In order to settle definitely the question, a series of cross inoculations were carried out to test their powers of infection. *Ascochyta* derived from *Sphaerella pinodes* was placed on *Vicia villosa* and *Ascochyta* from *Sphaerella viciae* was placed on pea plants.

Checks were also run but as they simply show the virulence of each form, the check experiments are omitted from the table.

Series I.

Ascochyta pisi on *Vicia villosa*. Source of material *Sphaerella pinodes* from *Pisum sativum*.

Date	Trial Host	No. of Plants	No. Infected	Date
May 20, 1912	*Vicia villosa*	3	2	June 1, 1912
June 4, 1912	*Vicia villosa*	2	1	June 16, 1912
June 18, 1912	*Vicia villosa*	5	2	June 30, 1912
July 17, 1912	*Vicia villosa*	2	2	Aug. 1, 1912

In no case were the spots numerous or extensive. Usually small and poorly developed.

Series II.

Ascochyta from *Sphaerella* on *Vicia villosa* placed on *Pisum sativum*.

Date	Trial Host	No. of Plants	No. Infected	Date
June 4, 1912	*Pisum sativum*	2	2	June 16, 1912
June 18, 1912	*Pisum sativum*	4	3	June 30, 1912
June 26, 1912	*Pisum sativum*	2	2	July 6, 1912

In this case the spots were not numerous but quite typical.

Although the *Ascochyta* derived from *Sphaerella pinodes* did not, in all cases, infect the *Vicia villosa* there were enough positive results to show that infection takes place. The reverse infection, the *Ascochyta* from the *Sphaerella* from *Vicia villosa* placed on *Pisum sativum* were uniformly successful.

This then is conclusive evidence that the fungi on the two hosts, *Vicia villosa* and *Pisum sativum* are the same species.

The name *Ascochyta viciae* Lib. has been used for an *Ascochyta* occurring on *Vicia sativa*. Specimens so labeled do not appear to differ form the *Ascochyta* on *Vicia villosa*. Inoculations were made on *Vicia sativa* with *Ascochyta* cultures derived from the pea and also from *Vicia villosa* and the following results were obtained.

Source of Material	Trial Host	Date	Result	Date
Pea	*Vicia sativa*	June 18, 1912	*Ascochyta*	July 3, 1912
Pea	*Vicia sativa*	June 18, 1912	*Ascochyta*	July 3, 1912
Vicia villosa	*Vicia sativa*	June 18, 1912	*Ascochyta*	July 8, 1912
Vicia villosa	*Vicia sativa*	June 18, 1912	*Ascochyta*	July 3, 1912
Vicia villosa	*Vicia sativa*	June 18, 1912	Negative	
Vicia villosa	*Vicia sativa*	June 10, 1912	*Ascochyta*	June 21, 1912
Vicia villosa	*Vicia sativa*	June 10, 1912	*Ascochyta*	June 21, 1912

Although in the field I have seen very little *Ascochyta* on *Vicia sativa*, the inoculation experiments show that it is also capable of acting as a host for *Ascochyta pisi*.

Since some collectors have used the name *Ascochyta pisi* for a fungus occuring on *Lathyrus odoratus*, trials of the *Ascochyta* from both pea and hairy vetch were made on seedlings of the sweet pea with the results shown in the following table.

Source of Material	Trial Host	Date	Result
Ascochyta on Pea	*Lathyrus odoratus*	June 4, 1912	*Ascochyta*
Ascochyta on Pea	*Lathyrus odoratus*	June 20, 1912	*Ascochyta*
Ascochyta on Pea	*Lathyrus odoratus*	June 20, 1912	Negative
Ascochyta on Pea	*Lathyrus odoratus*	June 24, 1912	*Ascochyta*
Ascochyta on Pea	*Lathyrus odoratus*	June 24, 1912	*Ascochyta*
Ascochyta on Pea	*Lathyrus odoratus*	July 17, 1912	Negative
Ascochyta on *Vicia*	*Lathyrus odoratus*	July 17, 1912	*Ascochyta*
Ascochyta on *Vicia*	*Lathyrus odoratus*	July 17, 1912	Negative

Infection took place almost entirely on the leaves. The infected leaves became very much blackened and shriveled and in some cases fell away. This is not a typical appearance but careful microscopic examination of the diseased leaves always revealed pycnidia and pycnospores of the usual *Ascochyta* type.

From these results I conclude that *Lathyres odoratus* may act as host for *Ascochyta pisi* and that the collectors are correct in applying the name *Ascochyta pisi* to the fungus infecting this plant.

A number of trials of *Ascochyta* from both pea and vetch have been made on *Phaseolus vulgaris* and *Phoseolus lunatus*, both on the green plants and on the detached pods. So far only negative results have been obtained.

Likewise negative results have been secured in attempts to inoculate *Melilotus* and *Medicago* with *Ascochyta* from the pea and hairy vetch.

Sphaerella on Everlasting pea.
(Lathyrus? latifolius.)

In 1890 Ellis collected at Newfield, N. J., a *Sphaerella* on Everlasting pea, which he labelled *Sphaerella melaena* (Fr.) *Auersw.*

According to Schroeter in Cohn's Kryptogamenflora and also in Rabenhort's Kryptogamenflora. *Sphaerella melaena* belongs in the genus *Ascospora*, a genus characterized by its one celled ascospores and the perithecia covered by a subiculum. Neither of these characters are possessed by the *Sphaerella* collected by Ellis. It is a true *Sphaerella* having no subiculum and two celled ascospores[1]).

[1]) Ex. Herb. N. Y. Bot. Gardens. Ellis Collection.

The perithecia are 80—150 microns in diameter, asci 10—12 × 50—70 microns, thickened at the apex and with a pore; ascospores 4,5—5 × 12—14.

These measurements agree with those for *Sphaerella pinodes* except that the spores are a trifle small. Some of the characters of the spores, however, tend to show that they are young, that is, the spores are pointed and show indications of guttulae.

Since *Lathyrus odoratus* may act as a host for *Ascochyta pisi* we have very good reason for considering that the *Sphaerella* collected by Ellis on Everlasting pea is also *Sphaerella pinodes*.

Besides *Ascochyta pisi* and *Ascochyta viciae* several more species of this genus have been described on members of the tribe *Viciae* and closely related plants. Most of these species according to their descriptions, agree fairly well with *Ascochyta pisi* Lib. and although there is a slight difference in the spot described and in the size of the spores they lie within the limits of variation as I find them for the Ascochyta on the pea[1]).

Outside of the tribe Viciae, also, a number of species have been described some of which approach very closely, morphologically, to *Ascochyta pisi* while others are further removed. Of these, *Ascochyta phaseolorum* Sacc. on *Phaseolus vulgaris* is perhaps the nearest. Since I have been unable to infect either *Phaseolus vulgaris* or *Phaseolus lunatus* with the *Ascochyta* from either pea or vetch I am inclined to think that this is a distinct species and that the specimens of *Ascochyta* on *Phaseolus* called *Ascochyta pisi* should be changed to *Ascochyta phaseolorum* Sacc.

Ascochyta Boltshauseri Sacc. on *Phaseolus* is without doubt a distinct species as the spores are very much larger than any of those occurring on the vetch or pea.

Ascochyta medicaginis Bres. on *Medicago* is no doubt a distinct species. Its host is widely removed from the tribe in which *Vicia* and *Pisum* occur, being closely allied to *Melilotus*. Furthermore Bubak(5) has, at least provisionally, connected this species with a *Pleosphaerulina*.

The *Ascochyta* occurring on Melilotus is very different from the one on pea, both in morphological characters and in its reactions in nutrient media.

As no complete account of the *Sphaerella pinodes* has ever been given, together with all of its spore forms, it seems desirable to give a technical

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[1]) *Ascochyta lathyri* Trail on *Lathyrus silvestris* and *Lathyrus odoratus*.
Ascochyta pisicola (Berk.) Sacc. on *Pisum sativum*.
Ascochyta vicicola Sacc. on *Vicia sepium*.
Ascochyta orobi Sacc. on *Orobus vernus* and *Orobus lathyroides*.
Ascochyta ervicola Syd. on *Erum hirsutum*.
Ascochyta viciae-pisiformis Bub. on *Vicia pisiformis*.
Ascochyta viciae-lathyroidis Syd. on *Vicia lathyroides*.
Ascochyta fabae Speg. on *Faba vulgaris*.
Ascochyta pisi forma *foliicola* Sacc. on *Pisum sativum*.

description together with the synonomy as I understand it. I have considered as the true host only plants in the tribe *Viciae*, listing first those I have actually proven to be the host. I have also used the genus name *Mycosphaerella*, following the more recent usage of Lindau, Schroeter and others.

Mycosphaerella pinodes (Berk. und Blox.) Comb. Nov.

Sphaeria pinodes (Berk. and Blox.) in Ann. N. H. 981.
Sphaerella pinodes (Berk. and Blox.) Niessl F. Eur. 1947.
Sphaerella viciae Schroet. Nord. Pilze p. 10.
Ascochyta pisi Lib. Exs. 12.
The following need verification.
Sphaeria (Depazea) concava Berk. Ann. N. H. n. 194.
Zythia rabiei Pass. sec. Sacc. Syll. Fung. **3**, 397.
Ascospora pisi Fckl. Symb. Myc. p. 94.
Septoria leguminis β. *pisi* Kickx sec. Sacc.
Phyllosticta Robergii Desm. Pl. Crypt. ex. 885.

Perfect Stage. Caulicolous and fructicolous; perithecia brown, 100—300 microns in diameter, deeply sunken in the substratum or only under the epidermis, partially erumpent, ostiolum central more or less elongated into a beak or rostrum. Wall of the perithecium pseudo-parenchymatous, one to three layers of cells thick. Asci 12—16 ⩒ 60—80 microns, cylindrical to cylindrical-clavate; inner wall with a pore in the thickened apex. Spores 8; 6—8 ⩒ 12—15 microns, hyaline, elliptical-obovate, two celled, the upper cell larger, each biguttulate when young but the content becoming uniform at maturity.

Pycnidial Stage. Caulicolous, foliicolous, fructicolous, forming discolored areas on young, succulent parts but without such areas on mature parts of the same plant. Pycnidia brown, erumpent, globose, 100—280 microns in diameter; wall thin and pseudo-parenchymatous, ostiolum central; spores hyaline, cylindrical, rounded at each end, one celled and guttulate when young, without guttulae at maturity, mostly uniseptate, sometimes biseptate, 3—6 ⩒ 9—20 microns.

Perfect stage saprophytic on stems and pods of *Pisum sativum*, *Vicia villosa*, *Vicia cracca*, Everlasting pea, *Lathyrus odoratus*. August until June. Europe and North America.

Pycnidial stage parasitic and saprophytic on *Pisum sativum*, *Lathyrus odoratus*, *Vicia sativa*, *Vicia villosa*. Also reported on *Pisum arvense*, *Cicer arietinum*, *Vicia americana*, *Vicia caroliniana*, *Vicia hirsuta*, June until October. Europe and North America.

American Collections.

Both *Sphaerella pinodes* and *Sphaerella viciae* were described from European material and I can find no record of any collection of the perfect

stage in America until they were collected here. Professor George F. Atkinson first collected the perfect stage of *Sphaerella viciae* on *Vicia villosa*, here, in April 1909. I collected the same fungus here in October 1910 and again from August 12, 1911 until June, 1912 and August 19, 1912.

I first collected *Sphaerella pinodes* on *Pisum sativum* here at Ithaca, N. Y. October 1910 and again September 1, 1911; at Cortland, N. Y. September 11, 1911 and at Oneida, N. Y. September 20, 1911. It has also been collected by Mr. C. D. Learn at Moscow, Pa. in September, 1911 and January 1, 1912.

Economic importance.

From an economic standpoint *Ascochyta pisi* is of considerable importance, especially in regions where truck farming, market gardening or the canning industry is carried on extensively.

The fungus often causes epidemics of blight and a large percentage of the pea crop will be lost. Combes[1]) reports such an epidemic in Europe in 1879. Krüger(27) records another in Germany in 1894. In New Jersey the disease was very severe in 1893(22), the main loss being caused by the failure of the pea seed to grow because much of it was infected the previous year. During the years 1903—4—5 truck growers in Ohio suffered heavy loss from the "blight". It has been estimated that in 1905 52 % of the pea crop in Ohio was lost(43).

Carruthers(7) reports a severe outbreak of the fungus on "beans" in England in the summer of 1898. In English literature the term "bean" is usually applied to the flat bean, *Vicia faba*[2]) and the term French bean or haricot to *Phaseolus vulgaris*. On this statement of Carruthers is based the report that *Ascochyta pisi* occurs on *Phaseolus vulgaris*(43).

Little has been accomplished in the way of finding methods for the control of the disease.

Spraying does not seem to be very effective(34, 45). As in the case of bean anthracnose, the seeds may become infected so that the fungus may readily attack the seedling. Seed treatment can not be used as the seed is injured before the fungus is destroyed.

Stone(41) of Massachusetts has shown that an *Ascochyta* disease of radishes may be controlled by soil sterilization but this, of course, can not be used where peas are grown on an extensive scale.

At present about the only method of holding in check the disease due to this fungus is to secure seed free from *Ascochyta* and plant in soil free from the fungus.

In pea growing it is recommended that a careful crop rotation be practiced, so that peas do not come oftener than once in two years. Many successful pea growers use a four year rotation.

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[1]) Combes. Crittogamia Agraria p. 473.

[2]) Bailey, L. H. Encyclopedia of Agriculture.

The life history of Ascochyta lethalis (Ell. and Barth).

Melilotus alba and *Melilotus officinalis* are subject to the attack of an *Ascochyta* which has been described by Ellis and Bartolomew and named by them *Ascochyta lethalis*[1])(17). The fungus attacks the plants in their seedling stage and also plants of the second seasons growth.

When infection first takes place dark areas are formed on the green stems. Then as the fungus spreads the spot becomes oval to elliptical with a grayish white center and a brown, raised border. The brown pycnidia appear scattered over the whitish area. The spots may become confluent and very extensive.

Very frequently the stems become girdled and then the upper parts of them die. This takes place most frequently in young seedlings and early in the season of the second years growth. The more mature plants are seldom killed and the diseased areas may become spread over nearly the whole upper part of the stem, including the small branches in the flower clusters.

The fungus remains on the stems in the pycnidial stage until the following summer as a saprophyte and may be readily isolated from the dead stems as late as August of the year following its first appearance.

Laubert has described a very similar fungus on *Melilotus alba* from Germany, which he has named *Ascochyta caulicola* (38).

The pycnospores of *Ascochyta lethalis* germinate readily in water and nutrient media in about twelve hours. In germinating their behavior is similar to that of the spores of *Ascochyta pisi*.

In bean pod agar the colonies become visible to the naked eye on the third day as fine white lines radiating from a central point. The mycelium, however, is not uniform as in *Ascochyta pisi* but even in very early stages numerous enlarged cells may be seen in the hyphae. Sometimes these enlarged cells are single, sometimes in chains of three or more, usually intercalary but often appearing terminal. By the fourth day the cells begin to take on a brown color and finally become more or less thick walled. They are, apparently, chlamydospores.

When these chlamydospores are numerous the pycnidia are slow to develop. I have not been able to determine the condition for the formation of these chlamydospores. Often in the same plate some colonies will develop chlamydospores and others very few of them, while pycnidia will be present.

Pycnidia may appear as early as the fifth day in colonies with few chlamydospores and may be retarded until the seventh or eighth day when chlamydospores are numerous.

[1]) My material has been examined by Bartholomew and identified by him as *Ascochyta lethalis* Ell. and Barth.

The pycnidia are always darker, less numerous and more scattered than in *Ascochyta pisi*.

On bean pod agar, to which 20 % cane sugar has been added, the growth is somewhat more luxuriant than in plain bean pod agar but is otherwise not changed in character. Pycnidia are slow to develop but in colonies two weeks old they become very numerous.

On potato agar the growth is very dense forming bluish brown colonies, the chlamydospores are very numerous and pycnidia are very slow to develop.

On beef extract-peptone agar a slightly more luxuriant growth is formed than on bean pod agar, with somewhat more numerous chlamydospores. Hence parts of the colony are a deeper brown. The chlamydospores are not evenly distributed but are formed in radiating lines or strands. Here, again, pycnidia are slowly developed but a few are formed in seven days.

On bean pods the fungus grows readily but with little mycelium on the surface. The colony quickly becomes very dark brown, almost black, due to the very numerous chlamydospores. Pycnidia develop quite freely but not in such large numbers as in *Ascochyta pisi* under the same conditions.

On sterilized sections of Melilotus stems growth is somewhat the same and as in the other cases the chlamydospores are characteristic of the species.

On corn meal the growth does not differ essentially from that already described.

In this development of chlamydospores, *Ascochyta lethalis* differs from *Ascochyta pisi* in somewhat the same way that the different strains of *Phyllosticta pirina* are said to differ from each other (11). As these chlamydospores are formed in very young colonies they differ very materially from the conidia like bodies found in old mycelium of *Gloeosporium fructigenum*, described and figured by Miss Stoneman (42) in her work on Anthracnoses.

A Mycosphaerella on Melilotus.

Associated with this *Ascochyta* on *Melilotus* is a *Mycosphaerella*.

The perithecia begin to form on the living stems in September and are very numerous by the time the plants are mature.

The asci and ascospores may be found mature in late September and from that time on, until the middle of the following August, they may be found in all stages of development. Usually the perithecia are moderately sunken in the substratum, rarely as deep as the stele, and most often only a short distance below the epidermis. The perithecium is connected with the surface by a papilliform ostiolum which projects slightly above the surface, giving the effected plant the appearance of being covered with minute brown points.

The asci are similar in form and structure to those of *Mycosphaerella pinodes* but are slightly larger.

The ascospores are larger than those found on the pea, remain longer biguttulate and are more pointed.

The asci are made up of an outer, inelastic membrane and an inner, elastic membrane which is thickened at the apex and is pierced by a pore. The spores are ejected in the manner already described for *Mycosphaerella pinodes*.

As has been previously stated, this *Mycosphaerella* is constantly associated with the *Ascochyta lethalis*. I have never found it on plants that had not previously been attacked by the *Ascochyta*. Since the *Ascochyta* persists on the stems over winter the two forms are always intermixed after the perithecia have begun to form. For this reason it has been hard to isolate ascospores in order to watch growth from them. Most of my work with this fungus has been carried on late in the season in order to avoid, as much as possible, the pycnidial form.

Cultures.

Unless otherwise stated dilution plates were poured and then plate No. 1 was searched carefully for ascospores before germination had taken place. The positions of individual ascospores were marked on the bottom of a Petri dish and then with a sterile needle a small bit of agar was cut out and transplanted to another dish. If care is taken to select scattered ascospores and only a small bit of agar removed, only one spore will be found in the block as can be told by the fact that the colony resulting can be traced back to a single spore.

The following table will show the number of ascospores which were planted and the resulting colony recorded.

Date	No. of Spores	Result	Date
May 24, 1911	6	5 *Ascochyta*	June 7, 1911
May 24, 1911	13	10 *Ascochyta*	June 19, 1911
June 21, 1911	6	6 *Ascochyta*	July 6, 1911
July 15, 1911	10	8 *Ascochyta*	July 25, 1911
July 28, 1911	10	8 *Ascochyta*	
Oct. 2, 1911	9	8 *Ascochyta*	Oct. 12, 1911

In the following cases ascospores were taken directly from the slide, under the microscope, with a sterilized needle and planted in agar.

Date	No. of Spores	Result	Date
Jan. 1, 1912	14	13 *Ascochyta*	Jan. 12, 1912
Feb. 27, 1912	6	6 *Ascochyta*	
Apr. 6, 1912	9	7 *Ascochyta*	Apr. 15, 1912
Aug. 3, 1912	9	6 *Ascochyta*	Aug. 12, 1912

In all the cases where the ascospore germinated and developed, a colony of *Ascochyta* was formed. The colony had the peculiar chlamydospores of the *Ascochyta lethalis* type and in those cases where the chlamydospores were numerous pycnidia formation was delayed, often until two weeks had passed. Where they were less numerous, pycnidia developed sooner and were mature in from seven to nine days.

Infection with Ascospore material.

In July 1911 pieces of *Melilotus* stems having numerous perithecia, containing viable ascospores, were placed in contact with young sweet clover plants under a bell jar and sprayed with water. After three days the bell jar was removed and the plants allowed to grow normally.

All of the plants in contact with the ascospore material developed the *Ascochyta*. Altogether ten plants were thus treated.

In the field the *Ascochyta* always develops first on plants near or in contact whith old *Melilotus* stems. Of course in both these cases it is impossible to be sure whether the infection comes from ascospores or pycnospores as both forms of the fungus remain in germinating condition on the old stems.

However, in the case of the experiments under the bell jar it was late in the season and the danger from infection by pycnospores was reduced to a minimum.

This much is, however, definitely shown, that the fungus winters over on the old stems and this is one source of infection the following year.

Infection with pure culture.

Ascochyta spores grown in pure culture from ascospores were placed on young plants of *Melilotus* and from these inoculations the typical *Ascochyta* lesions bearing pycnidia were developed.

The following table shows the number of plants inoculated and the results. In most cases where infection took place the lesions were quite characteristic.

Source of Material	Date	Trial Host	No. of Plants	Result	Date
Ascochyta from ascospores	May 5	*Melilotus alba*	3	2 *Ascochyta*	May 18, 1912
Ascochyta from ascospores	May 21	*Melilotus alba*	2	1 *Ascochyta*	June 4, 1912
Ascochyta from ascospores	June 15	*Melilotus alba*	3	1 *Ascochyta*	June 15, 1912

From these experiments it has been concluded that the *Mycosphaerella* on Melilotus, in this vicinity, is the perfect stage of *Ascochyta lethalis* Ell. and Barth.

The *Ascochyta* derived from ascospores has been grown on an variety of media but the perfect stage has not been found in culture.

The media used were as follows. Bean pod agar, bean pod agar plus 20% cane sugar, prune juice agar, potato agar, beef extract-peptone agar, bean pods, squash stems, potato tubes, corn meal and oat agar.

Attempts have been made to infect *Medicago sativa* but without success.

Identity of the fungus.

The *Mycosphaerella* occurring on Melilotus has been carefully compared with *Sphaerella Linhartiana* of Europe and differs from that species in the much larger asci and ascospores. In fact, the largest of the ascospores of *Sphaerella Linhartiana*[1]) are smaller than the smallest of the ascospores of our *Mycosphaerella*. The structure of the asci is apparently the same.

Professor Halsted has collected in New Jersey a *Sphaerella* on *Melilotus alba* which agrees perfectly with *Sphaerella Linhartiana* of Europe[2]).

Of course it has been impossible to secure cultures of *Sphaerella Linhartiana* so that I can judge only from morphological characters.

I have decided that the fungus is not identical with the *Mycosphaerella pinodes* for the following reasons.

The asci and ascospores are larger than those of *Mycosphaerella pinodes*. The ascospores remain longer biguttulate and develop over a much longer period. The character of the *Ascochyta*, especially in culture, is very different from *Ascochyta pisi*, the most prominent difference being in presence of chlamydospores and the consequent black, radiating, more or less zigzag, brown areas in the colony. In inoculation work negative results have always been obtained when *Ascochyta pisi* was used on *Melilotus* or *Ascochyta lethalis* on pea or vetch.

Therefore I have decided that this *Mycosphaerella* is undescribed. Since it is connected with *Ascochyta lethalis* Ell. and Barth., I have used the specific name *lethalis* in order to avoid duplicating names.

Mycosphaerella lethalis (sp. nov.).

Ascochyta lethalis Ell. and Barth.

Perfect Stage. Caulicolous; perithecia brown, pseudoparenchymatous, sunken in the cortex or just below the epidermis, globose, 96—160 microns; ostiolum central, elongated into a beak, slightly protruding above the surface of the substratum; asci cylindrical to cylindrical-clavate, 14—16 × 65—80 microns, with a pore in the apex of the thickened wall. Spores hyaline, two celled, elliptical, sligthly constricted at the septum, each cell biguttulate at maturity, somewhat acute at the ends, 7—9 × 13—19 microns.

[1]) Fungi Hungarici No. 461, Linhart. Ex Cryptogamic Herbarium Harvard University.

[2]) Ex Herb. Ellis. from Herb. N. Y. Botanical Gardens.

Pycnidial Stage. Caulicolous; spots elliptical 2—3 millimeters in diameter, sordid white with slightly raised border, frequently confluent. Pycnidia semi-erumpent, globose-lenticular, 50—120 microns in diameter. Spores oblong cylindrical, obtuse at each end, little or not constricted at the septum, usually uniseptate, sometimes biseptate, 3—5 × 10—17 microns.

Perfect stage on living and dead stems of *Melilotus alba* and *Melilotus officinalis*, Ithaca, N. Y. September until August.

Pycnidial stage beginning as a parasite in June and remaining on the dead stems until August of the following year.

Melilotus alba and *Melilotus officinalis*, Ithaca, N. Y. and Stockton, Kansas.

The type specimen and also cotype material has been deposited in the Herbarium of the Department of Botany, Cornell University.

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Explanation of Figures (Plates XIX—XX).

Figures 1—50 were drawn with the aid of the camera lucida. Two different magnifications were used. All asci and spores were magnified 430 diameters. Perithecia and pycnidia magnified 215 diameters.

Plate XIX.

Fig. 1. Ascus of *Mycosphaerella pinodes* on pea about to discharge its spores.
Fig. 2. A mature ascus of the same showing the pore.
Figs. 3 & 4. Young asci of the same.
Fig. 5. Ascus and ascospores of the same nearly mature.
Fig. 6. Ascospores of the same. Young spores with oil drops, mature spores without oil drops.
Fig. 7. Germinating ascospores after about twenty four hours.
Fig. 8. Apex of an ascus showing the pore.

Fig. 9. Germinating ascospore after about twelve hours.
Fig. 10. Ascospores of *Sphaerella pinodes*. Krieger's Fungi Saxonici. 1426.
Fig. 11. Ascus of the same.
Figs. 12 & 13. Perithecia of *Mycosphaerella pinodes* showing variation in length of ostiolum.
Fig. 14. Perithecia of *Sphaerella pinodes*. Krieger's Fungi Saxonici. 1426.
Fig. 15. Asci of *Mycosphaerella pinodes* on *Vicia villosa* ready to discharge spores.
Fig. 16. Mature ascus of the same.
Fig. 17. Mature ascospores of the same.
Figs. 18 & 19. Germinating ascospores of the same.
Figs. 20 & 21. Ascus and apex of an ascus showing the pore.
Figs. 22 & 23. Perithecia of the same.
Fig. 24. Perithecium of *Mycosphaerella lethalis* R. E. Stone.
Fig. 25. Mature ascus of the same showing the pore.
Fig. 26. Mature ascospore showing guttulae.
Fig. 27. Young ascus.
Fig. 28. Germinating ascospores after twenty four hours.
Fig. 29. Germinating ascospore after thirty six hours.
Fig. 30. Chlamydospores of the Ascochyta derived from ascospores of *Mycosphaerella lethalis*.
Fig. 31. An ascus of *M. lethalis* about to discharge its spores.
Fig. 32. Asci of *Sphaerella Linhartiana*. Fungi Hungarici 461. Linhart.
Fig. 33. Ascospores of the same.
Fig. 34. Asci of *Sphaerella balsamorrhizae*, showing the pore. Baker's Plants of Nevada. 1230.
Fig. 35. Asci of *Mycosphaerella citrullina* showing the pore. Material received from J. G. Grossenbacher.
Figs. 36 & 37. Asci and ascospores of the *Sphaerella* on Everlasting pea, collected by J. B. Ellis.
Fig. 38. Pycnospores of *Ascochyta pisi* on the pea, showing variation in size to be found in a single mount.
Figs. 39 & 40. Pycnospores showing stages in germination.
Fig. 41. Germ tubes anastomosing.
Fig. 42. Pycnidia showing variation in size.
Fig. 43. Pycnidia of *Ascochyta pisi* on *Vicia villosa*.
Fig. 44. Pycnospores showing variations to be found in a single mount.
Figs. 45 & 46. Stages in germination of pycnospores.
Fig. 47. Pycnospores of *Ascochyta lethalis*.
Figs. 48 & 49. Stages in germination of the same.
Fig. 50. Pycnidia of the same.

Plate XX.

Figs. 51 & 52. Photomicrographs of perithecia of *Mycospharella pinodes* on the pea. × 270.

Figs. 53 & 54. Photomicrographs of perithecia of *Mycosphaerella pinodes* on *Vicia villosa*. × 270.

Fig. 55. Photomicrograph of a perithecium of *Mycosphaerella pinodes* on *Vicia villosa* pods collected in May, 1909. × 150. Contributed by Prof. Geo. F. Atkinson.

Fig. 56. Photomicrograph of a perithecium of *Mycosphaerella lethalis*. × 270.

Fig. 57. *Mycosphaerella pinodes* on pea stem. × 5.

Fig. 58. *Mycosphaerella pinodes* on pea pod. × 5.

Fig. 59. *Mycosphaerella pinodes* on *Vicia villosa* pod. × 5.

Fig. 60. *Mycosphaerella lethalis* on Melilotus stem. × 5.

Fig. 61. *Ascochyta pisi* on bean pod agar plus 20% cane sugar, 7 days old. × 5/7.

Fig. 62. *Ascochyta lethalis*. Same conditions.

Fig. 63. *Ascochyta pisi* on bean pod agar, 7 days old. × 5/7.

Fig. 64. *Ascochyta lethalis* under same conditions.

Fig. 65. *Ascochyta pisi* on potato agar, 7 days old. × 5/7. Seen by direct light.

Fig. 66. *Ascochyta lethalis* same conditions.

Fig. 67. *Ascochyta pisi* on potato agar, 7 days old. × 5/7. Seen by transmitted light.

Fig. 68. *Ascochyta lethalis* under the same conditions.

Fig. 69. *Chlamydospores* of *Ascochyta lethalis*. × 270.

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Wilson, M. A new species of Pyrenochaeta (Scottish bot. Rev. vol. I, 1912, p. 161—162).

Wolf, Fr. A. The perfect stage of Actinonema Rosae (Botan. Gazette vol. LIV, 1912, p. 218—234, tab. XIII).

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Jatta, A. Lichenes Asiae meridionalis lecti a Rev. B. Lüthi in Malabar et ab E. Long et W. Gollan in Himalaya (Bull. Orto bot. Napoli vol. III, 1911, 4 pp.).

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Olivier, abbé H. Les Pertusaria de la flore d'Europe (Bull. Géogr. bot. vol. XXI, 1912, p. 193—217).

Sandstede, H. Die Cladonien des nordwestdeutschen Tieflandes und der deutschen Nordseeinseln. II. (Abh. Nat. Ver. Bremen vol. XXI, 1912, p. 337—382, 3 tab.).

Referate und kritische Besprechungen[1]).

a) Fungi.

Bataille, Fr. Flore monographique des Cortinaires d'Europe (Bull. Soc. d'Hist. nat. du Doubs no. 21 (1911), 1912, 112 pp.).

Der Verf. gibt gute Bestimmungsschlüssel und Beschreibungen zu 289 europäischen *Cortinarius*-Arten nebst vielen Varietäten. Vorangeschickt sind Bemerkungen über den morphologischen Bau dieser Pilze und über die Einteilung der Gattung.

Ito, S. and **Sawada, K.** A new Exobasidium-disease of the tea plant (The Botan. Magazine Tokyo vol. XXVI, 1912, p. 237—241, 6 fig.).

Die Verff. fanden, daß in Japan und auf Formosa auf *Thea sinensis* ein *Exobasidium* vorkommt, das sich sowohl habituell (Flecke unregelmäßig, nicht begrenzt, nie rötlich und nicht aufgetrieben) wie auch mikroskopisch von *E. vexans* unterscheidet. Der Pilz wird wegen des retikulierten Hymeniums als *E. reticulatum* beschrieben.

Long, W. H. Two new Species of Rusts. (Mycologia vol. IV, 1912, p. 282—284).

Für die eine der beiden hier beschriebenen Uredineen wird vom Verfasser in Anlehnung an die durch J. C. Arthur aufgestellten Grundsätze für die Umgrenzung der Uredineengattungen ein neues Genus aufgestellt, das den Namen *Tricella* erhält. Dasselbe unterscheidet sich von *Phragmopyxis* nur dadurch, daß keine Aecidien- und Uredosporen gebildet werden. *Tricella acuminata* wurde auf *Coursetia glandulosa* in Arizona gefunden. Der Umstand, daß die Nährpflanze der gleichen Gattung angehört wie diejenige von *Phragmopyxis deglubens*, läßt unseres Erachtens deutlich erkennen, daß durch Anwendung der erwähnten Grundsätze sehr willkürliche Schranken zwischen nahe miteinander verwandten Pilzarten aufgerichtet werden.

Die andere in der vorliegenden Mitteilung beschriebene Pilzart ist *Peridermium inconspicuum* auf *Pinus virginiana*. Dietel (Zwickau).

Lyon, H. L. Iliau, an endemic cane disease. With an Appendix, by N. A. Cobb. (Report of work of the Exp. Stat. of the Hawaiian Sugar Planters' Assoc. Pathol. and Physiological Bull. no. 11, 1912, 31 pp., 10 fig., 1 tab.)

[1]) Die nicht unterzeichneten Referate sind vom Herausgeber selbst abgefaßt.

Das Zuckerrohr wird auf Hawai von einer endemischen Pilzkrankheit heimgesucht, deren Symptome sich namentlich dadurch auffällig bemerkbar machen, daß die Blattscheiden wie ein dichter Wams die Stengel umgeben und fest angeschmiegt sind. Verursacher ist *Gnomonia iliau* n. sp. mit der zugehörigen besonders stark auftretenden Conidienform *Melanconium iliau*. Der Pilz befällt die jungen Pflanzen und zwar an der unterhalb des Erdbodens befindlichen Blattbasis. Von hier breitet er sich weiter aus und verhindert die Entwicklung der Pflanzen. Kälteres, regnerisches Wetter fördert die Ausbreitung des Pilzes. Es werden alle Zuckerrohr-Sorten vom Pilze befallen.

Neger, F. W. Eine neue Blattkrankheit der Weißerle. (Naturw. Zeitschr. f. Forst- und Landwirtsch. vol. X, 1912, p. 345—350).

Verf. hat in Norwegen neben *Taphrina epiphylla* mit seinen charakteristischen Hexenbesen, aber noch viel häufiger, eine Blattkrankheit beobachtet, die sich in kreideweißen, meist ziemlich scharf umschriebenen Flecken von sehr verschiedener Ausdehnung auf der Oberseite der Blätter zu erkennen gibt. Der erste Eindruck erinnert an den Befall durch einen Mehltaupilz. Die genauere Untersuchung zeigt aber, daß das Myzel nicht oberflächlich, sondern im Mesophyll und namentlich der Epidermis ausgebreitet ist. Konidienbildungen sind weder an der Ober- noch an der Unterseite der Blätter zu entdecken. Dagegen treten bei genügend weit vorgeschrittener Entwicklung des Pilzes an der Blattunterseite Perithezien auf, die mit *Gnomoniella tubaeformis* Übereinstimmung zeigen. Bei näherer Untersuchung zeigt sich aber, daß der Pilz weder mit dieser noch mit anderen auf Weißerle vorkommenden *Gnomonia* und *Gnomoniella*-Arten identisch ist. Verf. schlägt daher vor, bis er in der Lage ist, einwandfreies bzw. reifes Perithezienmaterial zu bekommen, den Pilz *Gnomoniella albo-maculans* zu benennen. Schnegg (Freising).

Theissen, F. Le genre Asterinella (Broteria Ser. Botan. vol. X, 1912, p. 101—123, 20 fig.).

Die Gattung *Asterinella* hatte Verf. kürzlich für die nicht hyphopodiierten *Asterina*-Arten aufgestellt. Verf. gibt nunmehr eine genaue Beschreibung und einen Bestimmungsschlüssel für alle diejenigen Arten, die aus der Gattung *Asterina* und verwandten Gattungen ausgeschieden und zu *Asterinella* gestellt werden müssen. Es sind im ganzen 20 Arten, nämlich *A. flexuosa* (Wint.), *quinta* (Rac.), *diaphana* (Syd.), *malabarensis* (Syd.), *Cryptocaryae* (Cke.), *Phoradendri* (P. Henn.), *Uleana* (Pazschke), *cupressina* (Rehm), *leptotheca* (Speg.), *brasiliensis* (Wint.), *sublibera* (Berk.), *Epidendri* (Rehm), *cylindrotheca* (Speg.), *manaosensis* (P. Henn.), *Puiggarii* (Speg.), *multilobata* (Wint.), *Stuhlmanni* (P. Henn.), *intensa* (Cke. et Mass.), *Humiriae* (P. Henn.), *Winteriana* (Pazschke).

Die häufigste Art scheint *A. Puiggarii* zu sein, die in Süd-Amerika verbreitet und unter verschiedenen Namen beschrieben worden ist.

Wolf, Fr. A. The perfect stage of Actinonema Rosae (Botan. Gazette vol. LIV, 1912, p. 218—234, tab. XIII).

Verf. gibt zunächst eine ausführliche Beschreibung des Baues von *Actinonema Rosae*, berichtet sodann über die Keimungsverhältnisse der Konidien und erörtert die systematische Stellung des Pilzes. Der Pilz stellt keine Sphaeropsidee, sondern eine Melanconiacee dar, weicht jedoch von den typischen *Marsonia*-Arten durch die subcuticulare Entstehungsweise ab.

Im Herbste eingesammelte, von dem Pilze befallene Blätter legte Verf. zwecks Überwinterung im Freien in Drahtkäfige. Im darauffolgenden April hatte sich auf den Blättern die zugehörige Schlauchform entwickelt, für die Verf. eine neue Gattung, *Diplocarpon*, aufstellt. Der Schlauchpilz, den Verf. für eine *Microthyriacee* hält, ist recht eigenartig gebaut; er besteht aus einem rundlichen subcuticularen Schildchen mit eingesenktem Apothecium. Die Apothecien öffnen sich bei der Reife unregelmäßig sternförmig. Die Schläuche enthalten 8 zweizellige, hyaline Sporen. Die Askosporen keimten in künstlichen Medien nicht. Keimung ließ sich nur erzielen in auf Rosenblättern in feuchtem Raume befindlichen Wassertropfen, und zwar innerhalb 24 Stunden.

Mittels der Askosporen wurden frische Rosenblätter mit Erfolg infiziert; es wurde die Bildung der *Actinonema* konstatiert, so daß an der Zusammengehörigkeit der beiden Fruchtformen nicht mehr zu zweifeln ist. Die von Laubert und Schwartz früher ausgesprochene Vermutung, daß *Gnomoniella Rosae* (Fuck.) Sacc. zu der *Actinonema* gehöre, hat sich somit als hinfällig erwiesen.

Moesz, G. A gombák rendellenességei. Teratologie der Pilze. (Botan. Közlemények, 1912, Heft 3 –4, p. 105 –115, 8 fig. (Ungarisch). — Deutsch. Res. p. (23)—(31).

Verf. zitiert zunächst die von N. Filarszky zuerst gegebene übersichtliche Zusammenstellung der Anomalien der Pilzfruchtkörper und die Gruppierung der teratologisch ausgebildeten Fruchtkörper und führt dann innerhalb dieser Gruppierung eine Anzahl neuer Beispiele an, und zwar:

I. Anomalien des Myzels. Pseudocopulation bei *Penicillium crustaceum*,

II. Mißbildung des Fruchtkörpers. Morchelartige Anomalie auf der Oberfläche des Hutes von *Agaricus (Clitocybe) ericetorum*. (Auf der Tafel prächtig dargestellt.) Torsion des Fruchtkörpers *(Tylostoma mammosum)*. Abnormale Farbe des Fruchtkörpers (weißfarbige *Plicarietla constellatio*). Verwachsung des Fruchtkörpers.

III. Anomalie des Stroma bei *Cordyceps capitata*.

IV. Anomalie des Ascus bei *Dermatea carpinea*.

V. Anomalien der Sporen und Konidien. Hauptsächlich Gruppierung der Mißbildungen der Sporen von Uredineen.

VI. Anomalie der Sterigmen von *Puccinia silvatica*.

Dodge, B. O. Artificial cultures of Ascobolus and Aleuria. (Mycologia vol. IV, 1912, p. 218—222, tab. LXXII—LXXIII).

Verf. fand einen neuen *Ascobolus*, der auch in Kultur fruktifizierte. Der Pilz wird *Ascobolus magnificus* genannt; die außerordentliche Größe des Fruchtkörpers, der weiße Rand desselben, die Linie, welche sich über die Oberfläche der Sporen hinzieht, unterscheiden ihn von den bisher bekannten *Ascobolus*-Arten. Eine absolute Reinkultur gelang übrigens nicht; es fand sich in den Kulturen immer noch ein Parasit des *Ascobolus*, der noch nicht bestimmt werden konnte. Dagegen konnte Verf. Reinkulturen von *Aleuria umbrina* Boud. erzielen. Dieser Pilz kommt in Natur auf Brandstellen vor; die Sporen keimen am besten (ca. 90%), wenn sie 15 Minuten lang auf 70—80° F erhitzt worden sind.

Riehm (Berlin-Dahlem).

Andrews, F. M. Protoplasmic streaming in Mucor (Bull. Torr. Bot. Club vol. XXXIX, 1912, p. 445—499, 9 fig.).

Verf. arbeitete namentlich mit *Mucor stolonifer* und *M. Mucedo* und gelangte zu Resultaten, die meist Schroeter's Angaben über den gleichen Gegenstand bestätigten, aber in manchen Punkten doch abwichen. Die vom Verf. gewonnenen hauptsächlichen Resultate sind:

1. Die Zusammensetzung der Nährmedia ist für das richtige Wachstum der Mucorineen von großem Einfluß.

2. Die Protoplasmaströmung wird in vielen Fällen durch Transpiration bewirkt und zwar hängt der Grad der Strömung von der Intensität der Transpiration ab.

3. Durch Osmosis wird ebenfalls vielfach Strömung veranlaßt, z. B. bei Anwendung von Zucker. Die Schnelligkeit der Strömung hängt von der Konzentration der Zuckerlösung ab.

4. Während der durch Osmosis bewirkten Strömung findet keine peripherische Strömung oder keine Bewegung in entgegengesetzter Richtung statt.

5. Verletzung verursacht oder beschleunigt die Strömung nicht, sondern hat eher eine Verlangsamung einer etwa vorhandenen Strömung zur Folge. Wird eine Hyphe in zwei Teile geschnitten, so findet nur ein Ausfluß, aber keine Abtötung statt. Die Wunde verheilt und die Plasmaströmung wird wieder aufgenommen.

6. In Hyphen, deren Plasma im Stande ist zu strömen, vermag abwechselnde Beleuchtung und Verdunkelung die Strömung hervorzurufen resp. zu beschleunigen.

7. Ein plötzlicher Temperaturwechsel von mehreren Graden bewirkt Strömung.

8. Im Gegensatz zu Schroeter's Angaben kann Strömung sowohl in unverzweigten wie in verzweigten Hyphen auftreten.

Demelius, Paula. Beitrag zur Kenntnis der Cystiden. I. (Verhandl. k. k. zool.-bot. Gesellsch. Wien, 1911, p. 278—287, 1 tab.). — II. (l. c. 1911, p. 322—332, 1 tab.). — III. (l. c. 1911, p. 378—395, 2 tab.). — IV. (l. c. 1912, p. 97—108, 1 tab.). — V. (l. c. 1912, p. 110—124, 1 tab.).

Die Verf. berichtet in diesen fünf einzelnen Arbeiten über ihre Untersuchungen betreffend die Zystiden der Hymenomyceten. I. In der Einleitung wird auf die vorhandene Literatur hingewiesen und kurz angegeben, was die Verf. unter Paraphysen und Zystiden versteht. Letztere dürften in manchen Fällen ein Abwehrmittel gegen winzige Schädlinge aus dem Tierreiche darstellen (so bei *Panus stipticus*, *Mycena cohaerens*). In dem folgenden speziellen Teil werden 22 Agaricaceen behandelt. Von jeder Art werden die Sporen, Basidien, Zystiden, Sterigmen, Trama, Hut, Stiel kurz beschrieben und, was sehr wichtig ist, die genauen Größen aller dieser einzelnen Teile mitgeteilt. In vielen Fußnoten wird auf etwaige vorhandene Literatur hingewiesen.

II. In dieser Fortsetzung werden in gleicher Weise weitere 24 Agaricaceen, in Teil III ferner 35 Agaricaceen und in Teil IV noch 17 andere Agaricaceen behandelt.

V. Dieser Beitrag umfaßt nur Polyporeen und Hydneen. Behandelt werden 21 Arten. Die Zystiden dieser Gruppen zeigen nicht den Formenreichtum der Agaricineen. Bei den Polyporeen sind sie meist spindel- oder flaschenförmig, manchmal keulenförmig mit hakig gekrümmter Spitze und häufig gelb oder braun gefärbt. Die untersuchten Hydneen haben lineare bis spindelförmige, unscheinbare, wenig hervorragende Zystiden.

Faull, J. H. The Cytology of Laboulbenia chaetophora and L. Gyrinidarum (Ann. of Botany vol. XXVI, 1912, p. 325—355, 4 tab.).

Antheridien wurden bei den beiden genannten Arten nicht beobachtet. Das Procarp entwickelt sich aus einer einkernigen Endzelle eines Zweiges des Rezeptakulums; es besteht aus einem einkernigen Karpogon, einer einkernigen Trichophorzelle und einem verzweigten und septierten Trichophor. Aus den (komplizierten) Untersuchungen über die Vorgänge der Kernteilung und Kernverschmelzung geht hervor, daß

1. die Laboulbeniaceen echte Ascomyceten sind,

2. die einzige Kernverschmelzung im Lebenszyklus dieser Pilze im Askus stattfindet,

3. konjugierte Kernteilungen ein Charakteristikum der sexuellen Vorgänge bei den Schlauchpilzen sind. Neger (Tharandt).

Winterstein, E. und **Reuter, C.** Über die stickstoffhaltigen Bestandteile der Pilze (Centralbl. f. Bact. etc. II. Abt. vol. XXXIV, 1912, p. 566—572).

Die vorliegenden Untersuchungen wurden mit Steinpilzen (*Boletus edulis*) vorgenommen, und zwar wurde nacheinander der Alkohol-, Äther- und Wasserextrakt, sowie der Rückstand untersucht.

Im Alkoholextrakt fand sich außer Lezithin hauptsächlich Trimethylhistidin neben Adenin und Cholin. Ferner wurden Aminosäuren, namentlich racemisches Alanin isoliert.

Der wässerige Extrakt enthielt die gleichen Alloxurbasen wie der Alkoholextrakt. Außerdem konnte Guanidin und Tetramethylendiamin gefunden werden. An Aminosäuren wurden Alanin, Leucin und Phenylalanin aufgefunden, jedoch in geringerer Menge wie im Alkoholextrakt. Die Hauptmenge der flüchtigen Basen bildet das Ammoniak, neben dem auch Trimethylamin nachgewiesen werden konnte. Der Ätherextrakt enthielt außer Fett Cholesterin und etwas Lezithin.

Bei Verdauungsversuchen mit Pepsin erwies sich ungefähr ein Viertel des getrockneten Steinpilzes als verdauliches Eiweiß. Durch Trypsin ist ungefähr ein Drittel der Trockensubstanz des Steinpilzes verdaulich.

Schnegg (Freising).

Osterwalder, A. Eine neue Gärungsmonilia, Monilia vini n. sp. (Centralbl. f. Bact. etc. II. Abt. vol. XXXIII, 1912, 257—272).

Verf. hat aus einem vergorenen Apfelwein mit starker Säureabnahme den in großer Menge darin vorkommenden Pilz, eine Monilia, isoliert. Derselbe erwies sich als sehr gärkräftig mit untergärigem Charakter und zwar als die gärkräftigste von allen bisher bekannten Gärungsmonilien. Selbst bei hohen Säuregraden vermag sie sich noch zu entwickeln. Neben Alkohol wird auch flüchtige Säure und nicht flüchtige Säure gebildet. In Weinen, die von den gewöhnlichen Weinhefen bereits vollständig vergoren sind, vermag der Pilz noch eine intensive Nachgärung hervorzurufen. Schädliche Stoffe irgend welcher Art werden dabei aber nicht gebildet, so daß der Pilz nicht zu den schädlichen Gärungsorganismen gehört.

Angestellte Gärversuche haben gezeigt, daß der Pilz Laevulose und Dextrose am besten vergärt. Weniger gut werden Saccharose, Lactose, Galactose und schließlich Maltose vergoren. Dabei wird zum Teil viel flüchtige Säure gebildet.

Von *Monilia candida* unterscheidet sich der Pilz durch seine Fähigkeit, Rohrzucker auch außerhalb der Zelle zu invertieren. Sporenbildung ließ sich nicht nachweisen. Schnegg (Freising).

Will, H. Beiträge zur Kenntnis der Sproßpilze ohne Sporenbildung, welche in Brauereibetrieben und deren Umgebung vorkommen. V. Mitteilung nach Untersuchungen von J. Scheckenbach (Centralbl. f. Bact. etc. II. Abt. vol. XXXIV, 1912, p. 1—35).

Analog den früheren Untersuchungen über Sproßpilze ohne Sporenbildung hat Verf. neuerdings eine Gruppe von Torulaceen auf ihre chemisch-physiologischen, wie anatomisch-morphologischen Eigenschaften hin untersucht. Ohne auf Einzelheiten einzugehen, sei hervorgehoben, daß sich aus allen Untersuchungen wertvolle Richtpunkte für die Unterscheidung

der Torulaceen von anderen Gruppen von Sproßpilzen ohne Sporenbildung, sowie für die Unterscheidung der beiden Untergruppen der Torulaceen ergeben. Schnegg (Freising).

b) Lichenes.

(Bearbeitet von Dr. A. Zahlbruckner-Wien.)

Olivier, H. Les Pertusaria de la flore d'Europe. Étude synoptique, descriptive et géographique (Bull. Géograph. Botan. 1912, p. 193–216).

Die Arbeit zerfällt in zwei Teile. Der erste Teil bringt einen analytischen Schlüssel zur Bestimmung der europäischen Arten der Gattung *Pertusaria*, der zweite Teil die systematisch geordnete Aufzählung der Arten mit kurzen Diagnosen und Angabe des Verbreitungsgebietes. Verfasser führt für Europa 71 Arten an.

Sandstede, H. Die Cladonien des nordwestdeutschen Tieflandes und der deutschen Nordseeinseln. II. (Abh. Nat. Ver. Bremen, XXI, 1912, p. 337—382, 3 tab.)

Eine neuerliche Behandlung des Themas, über welches Verfasser im Jahre 1906 eine Studie der Öffentlichkeit übergab, auf Grund der Ergebnisse der Forschungen über die Stoffwechselprodukte der Cladonien von Hesse und Zopf. Es ergeben sich aus diesen mancherlei Änderungen in der Systematik der Cladonien, speziell im Formenkreis der *Cladonia rangiferina*.

Sandstede, H. Die Flechten des nordwestdeutschen Tieflandes und der deutschen Nordseeinseln. (Abhandl. herausg. v. d. naturwiss. Verein Bremen, Band XXI, 1912, p. 9—243.)

Von den deskriptiven Lokalfloren der neueren Zeit zeichnet sich die vorliegende vorteilhaft durch eine gründliche Durcharbeitung der Materie aus. Die Beschreibungen wurden nicht aus anderen Werken kritiklos übernommen, sondern sie sind auf Grund eigener Untersuchung eines reichen Materials aufgebaut; sie sind ausführlich und behandeln auch eingehend die Pyknokonidien und andere Nebenfruktifikationen, die, obwohl sie in manchen Artengruppen von großer Wichtigkeit sind, in anderen Lokalfloren eine recht stiefmütterliche Behandlung erfuhren.

Von einer allgemeinen Behandlung der Flechtenvegetation des Gebiets wurde abgesehen; der Schwerpunkt der Arbeit liegt in der deskriptiven Darstellung der bisher beobachteten Flechten. Als Grundlage der Anordnung wurde mit ganz geringen Abweichungen (bezüglich der Gattungen *Icmadophila* und *Variolaria*) das System des Referenten angenommen. Die Diagnosen sind in deutscher Sprache verfaßt; die höheren Gruppen knapp, die Arten und ihre Variationen ausführlich behandelt. Die vom Verfasser selbst geprüften Exsiccaten — und dies ist von Wert — sind kenntlich gemacht. Bei häufigen Arten wurde ein wiederholtes Aufzählen der Fundorte vermieden; vielfach wird diesbezüglich auf die ältere Literatur über das Gebiet hingewiesen.

Die Cladonien des Gebietes, welche Sandstede im Jahre 1906 in einer eigenen Arbeit ausführlich behandelte, fanden keine Aufnahme.

Als neu wurden beschrieben: *Verrucaria submucosa* B. de Lesd., *Verrucaria Sandstedei* B. de Lesd., *Opegrapha Chevalieri* f. *agglomerata* Sandst., *Opegrapha rubescens* Sandst., *Lecidea microspora* f. *tegularis* Sandst., *Lecidea promixta* f. *rupicola* Sandst., *Lecidea scabra* f. *lignicola* Sandst., *Rhizocarpon obscuratum* f. *macularis* Sandst., *Acarospora fuscata* f. *deusta* Sandst., *Acarospora murina* Sandst., *Lecanora nephaea* ver. *isidiosa* Sandst., *Parmelia saxatilis* f. *opaca* Sandst. und *Buellia (Diplotomna) atromaculata* Sandst.

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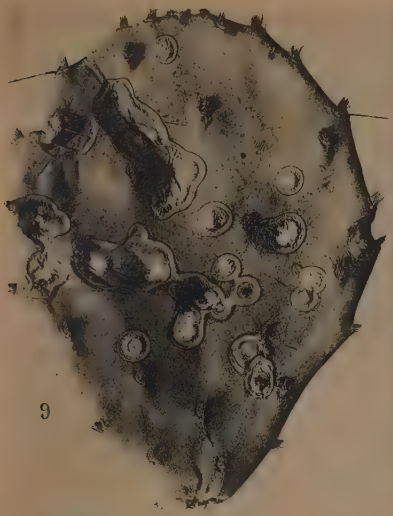
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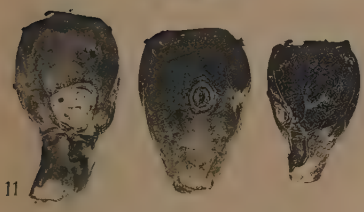
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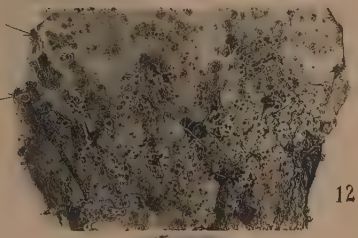
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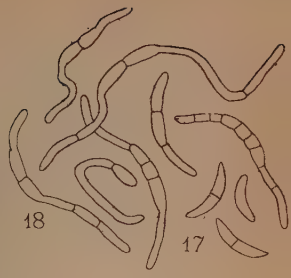

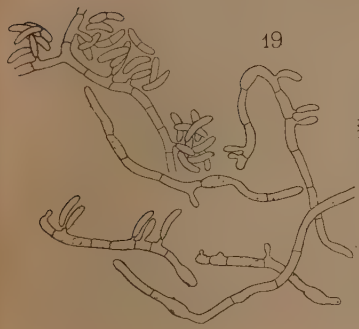

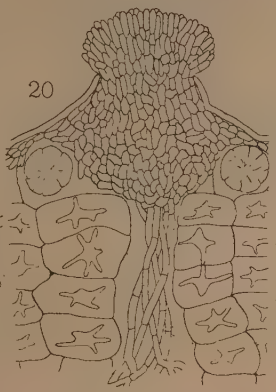

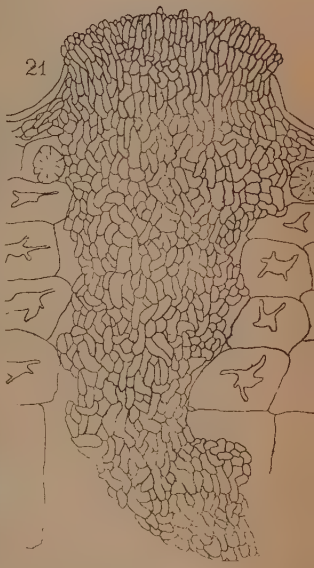

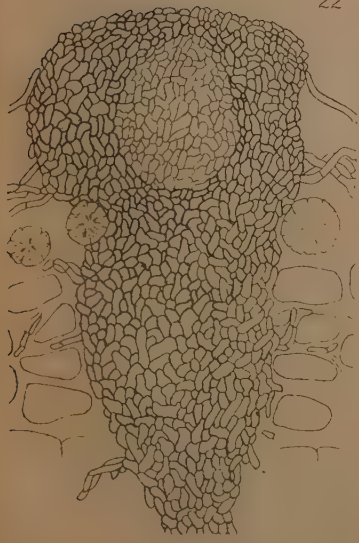

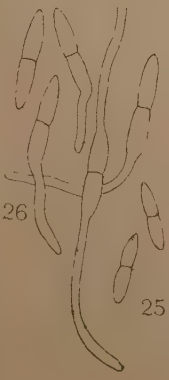

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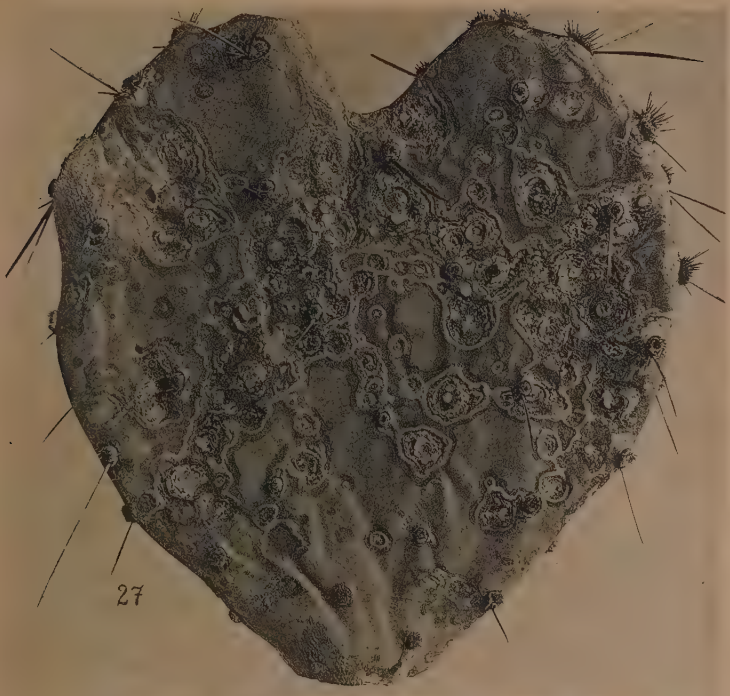

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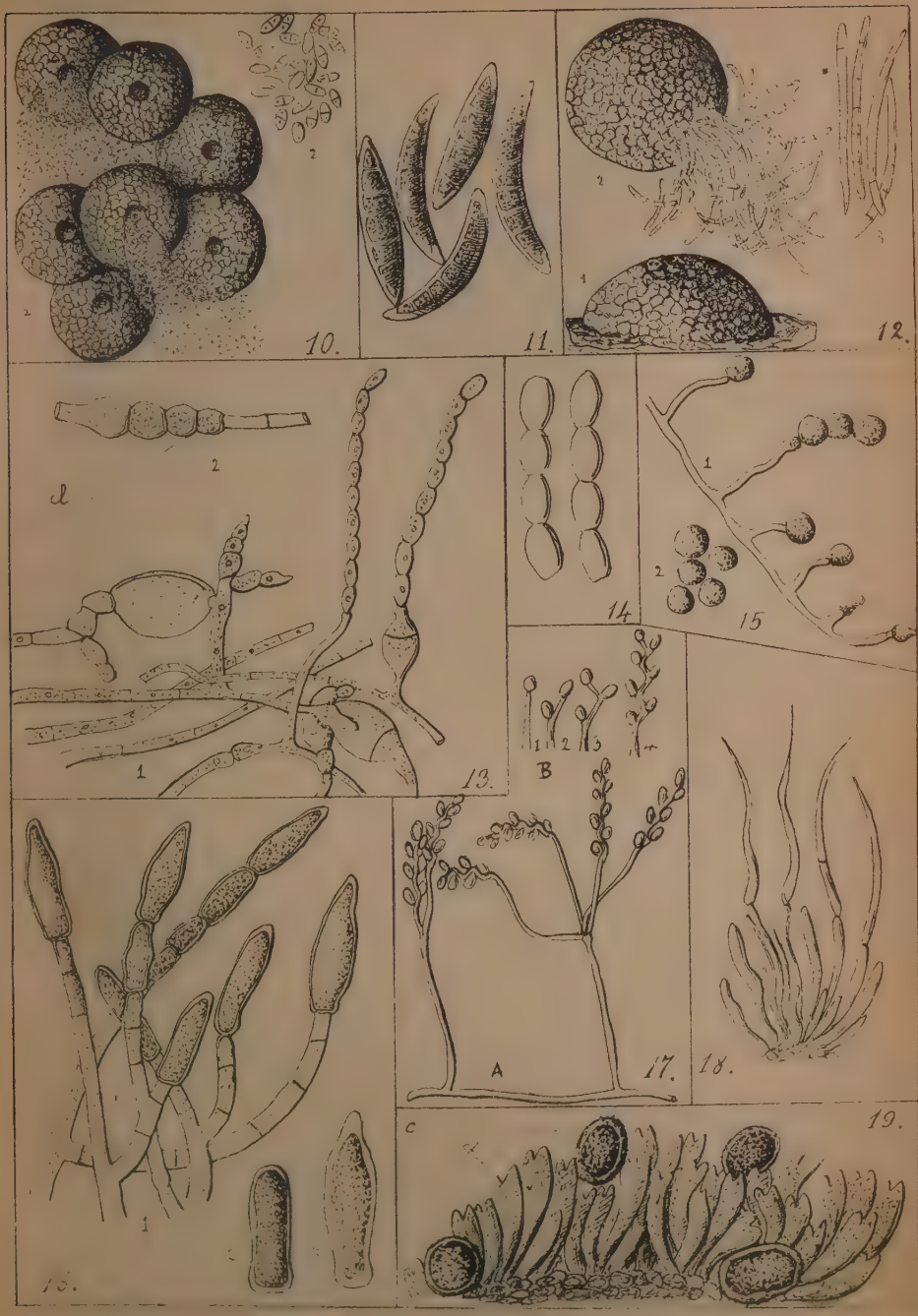

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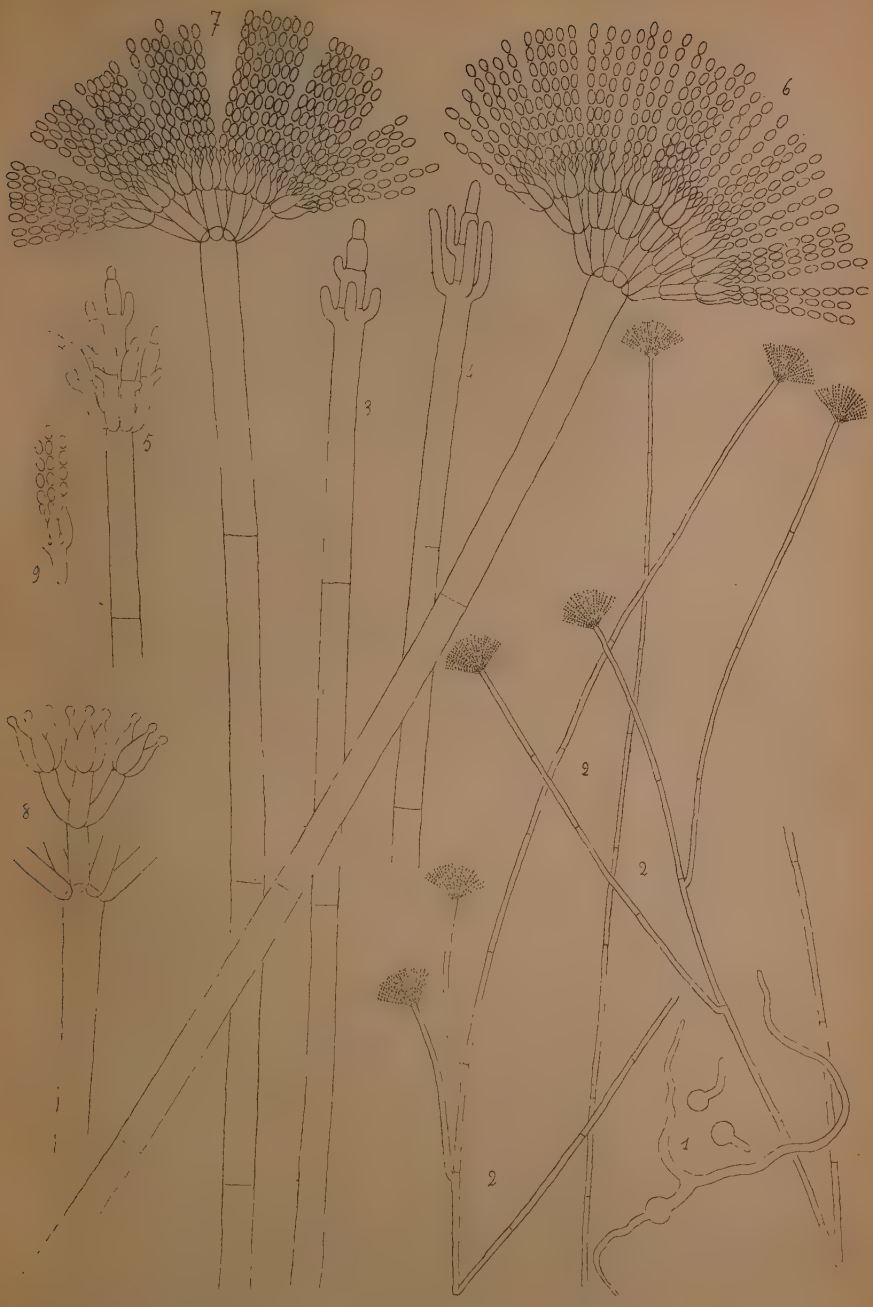

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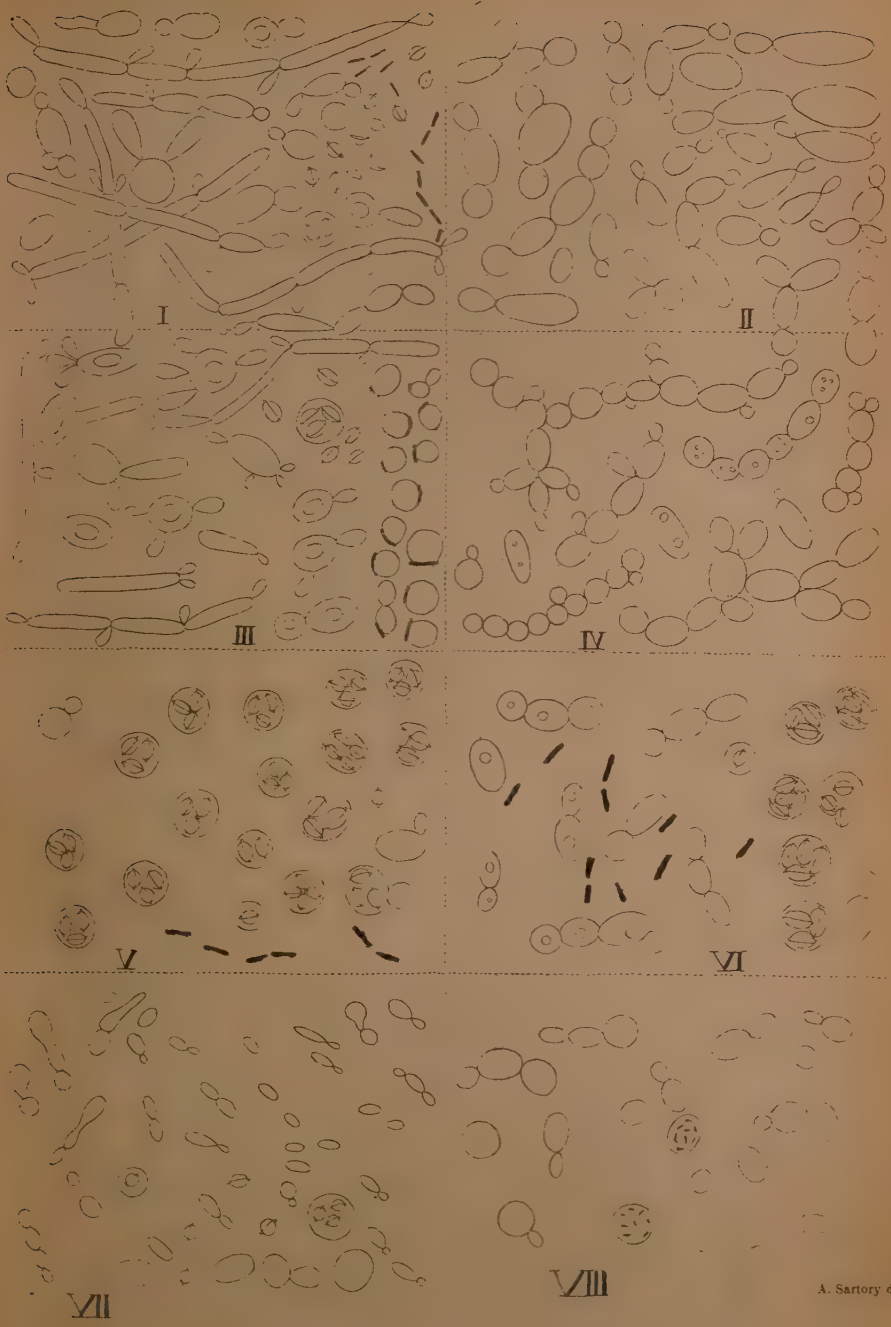

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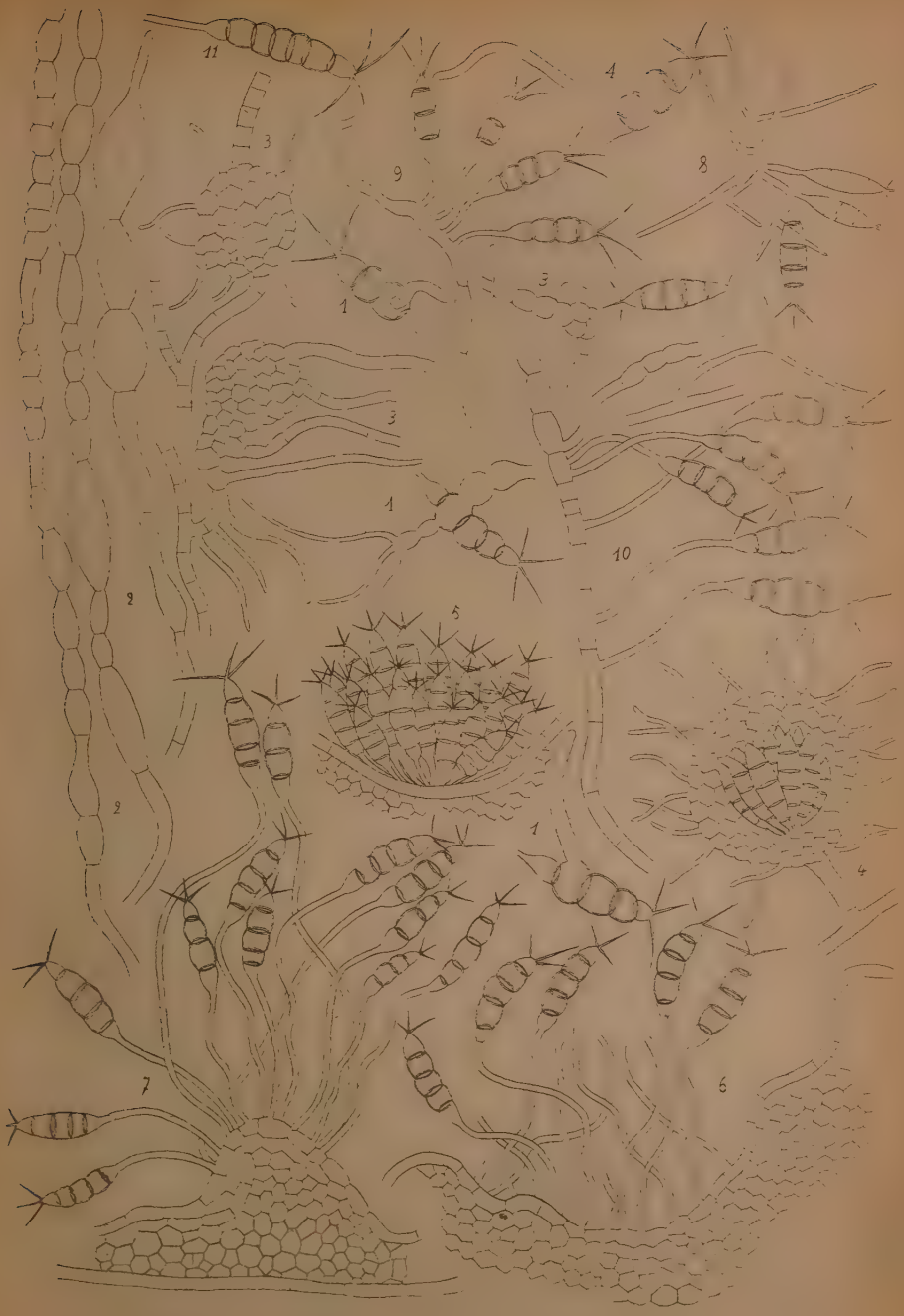

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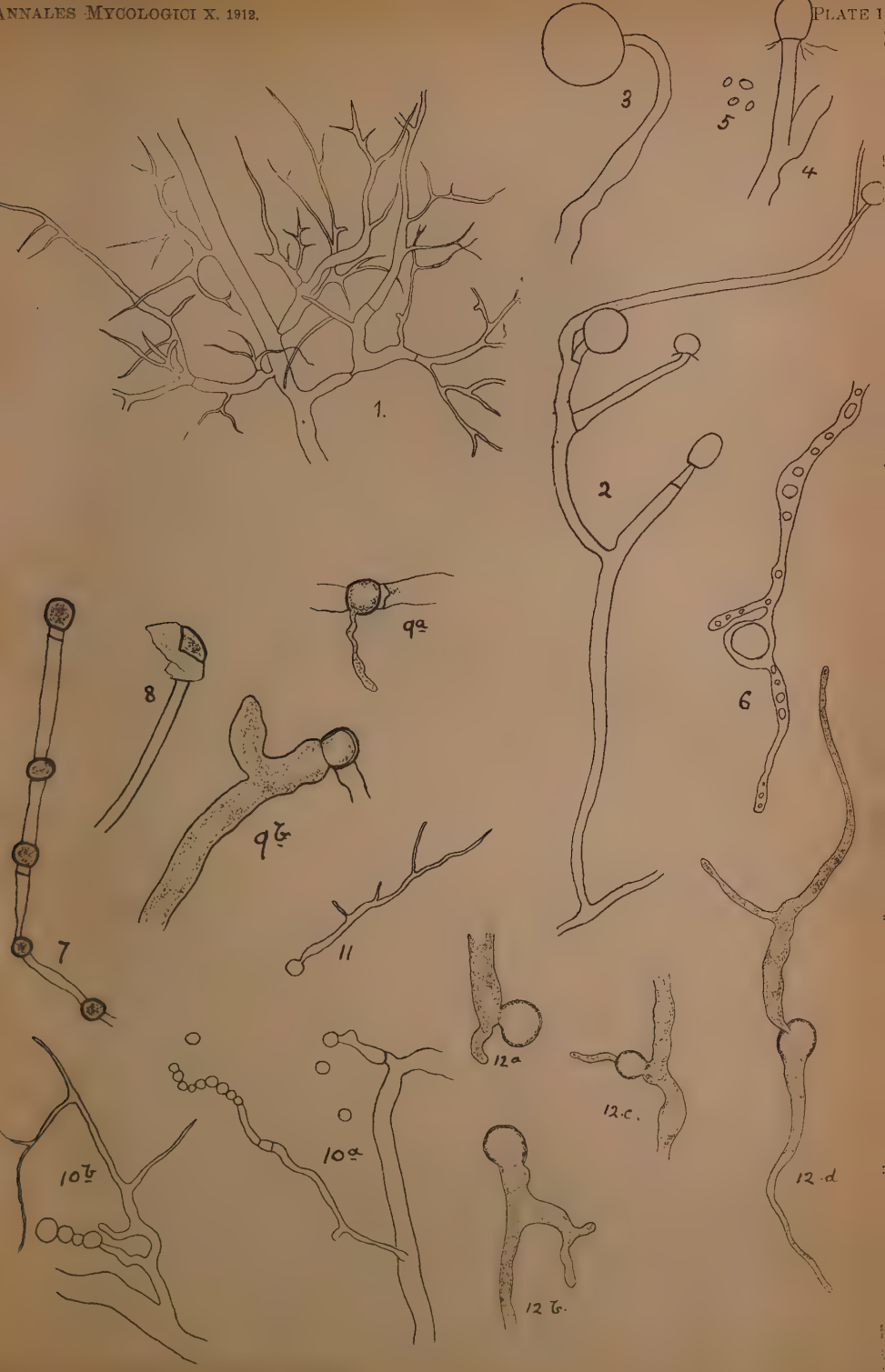

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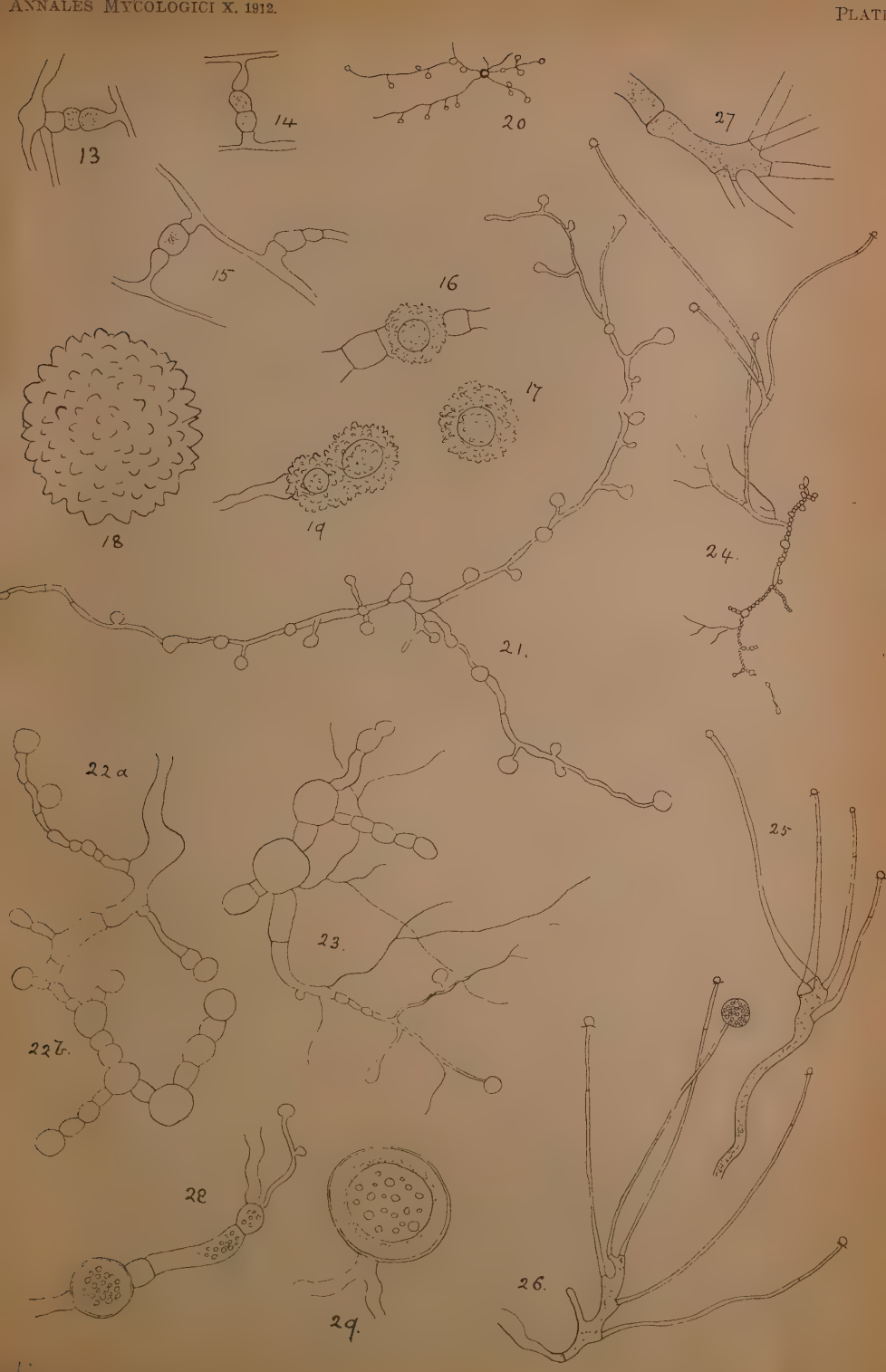

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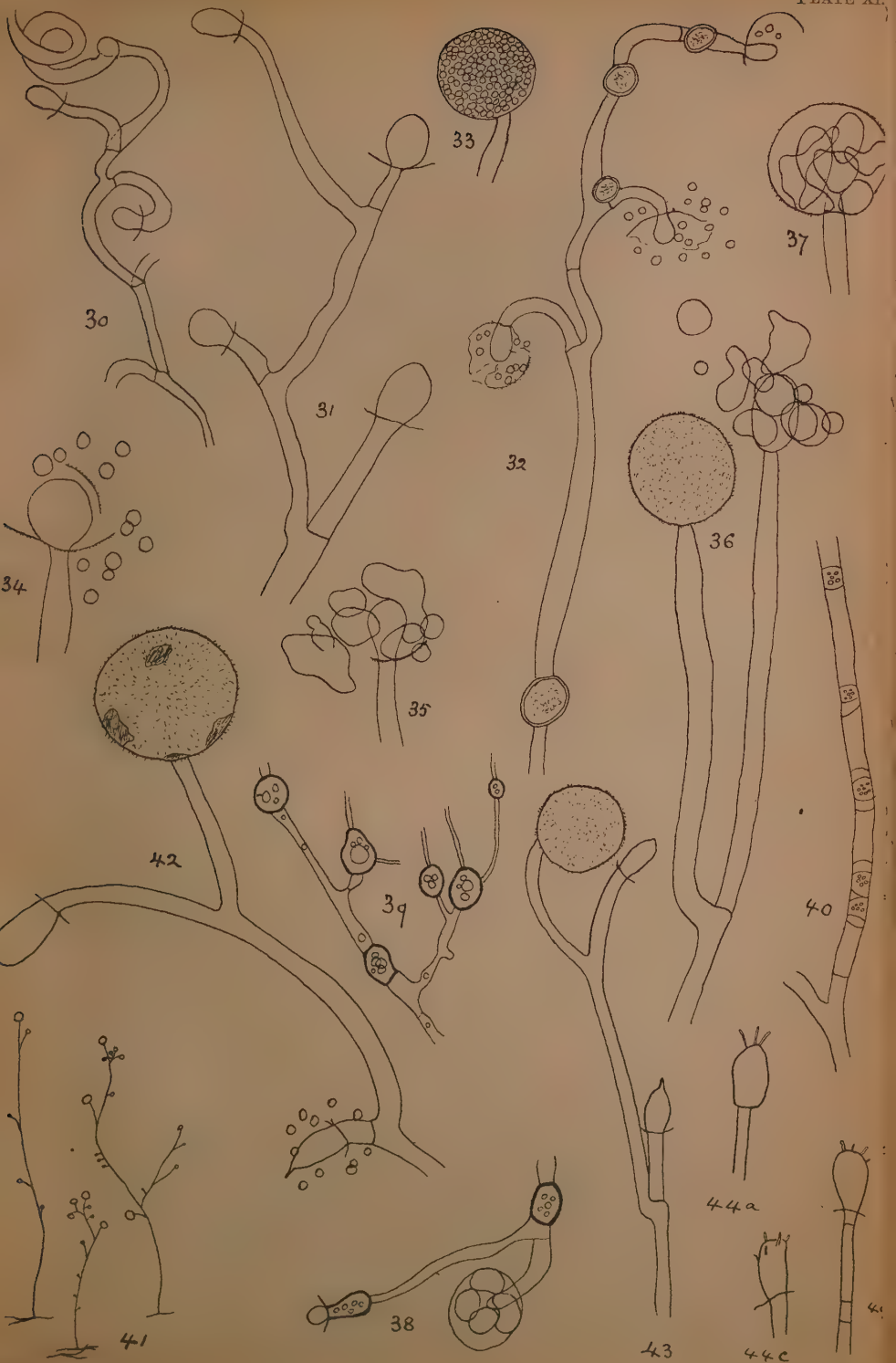

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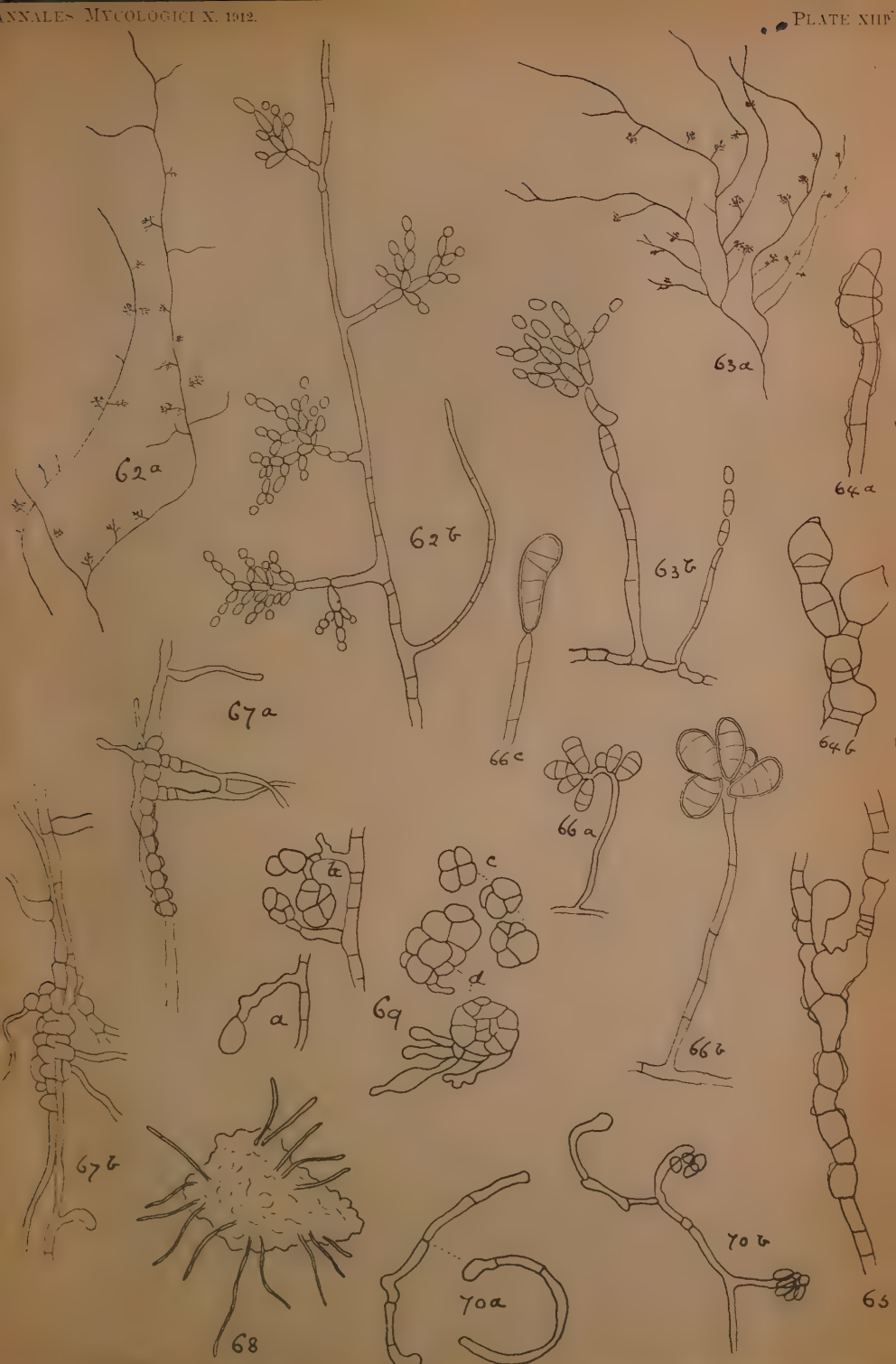

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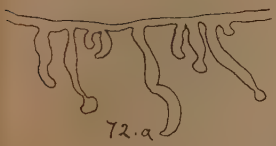

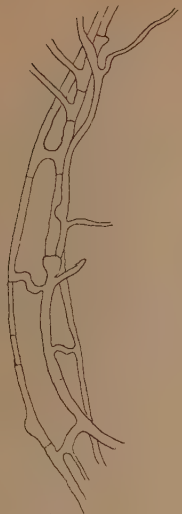

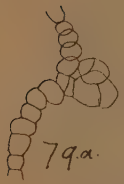

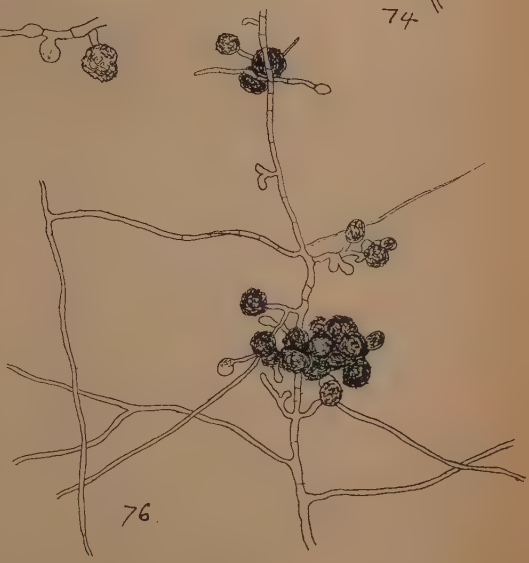

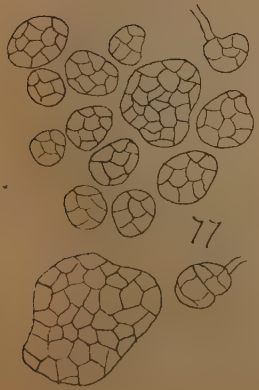

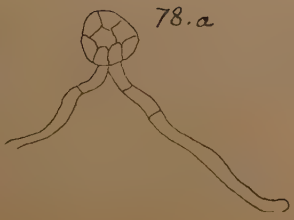

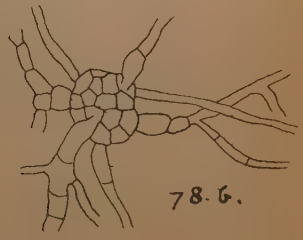

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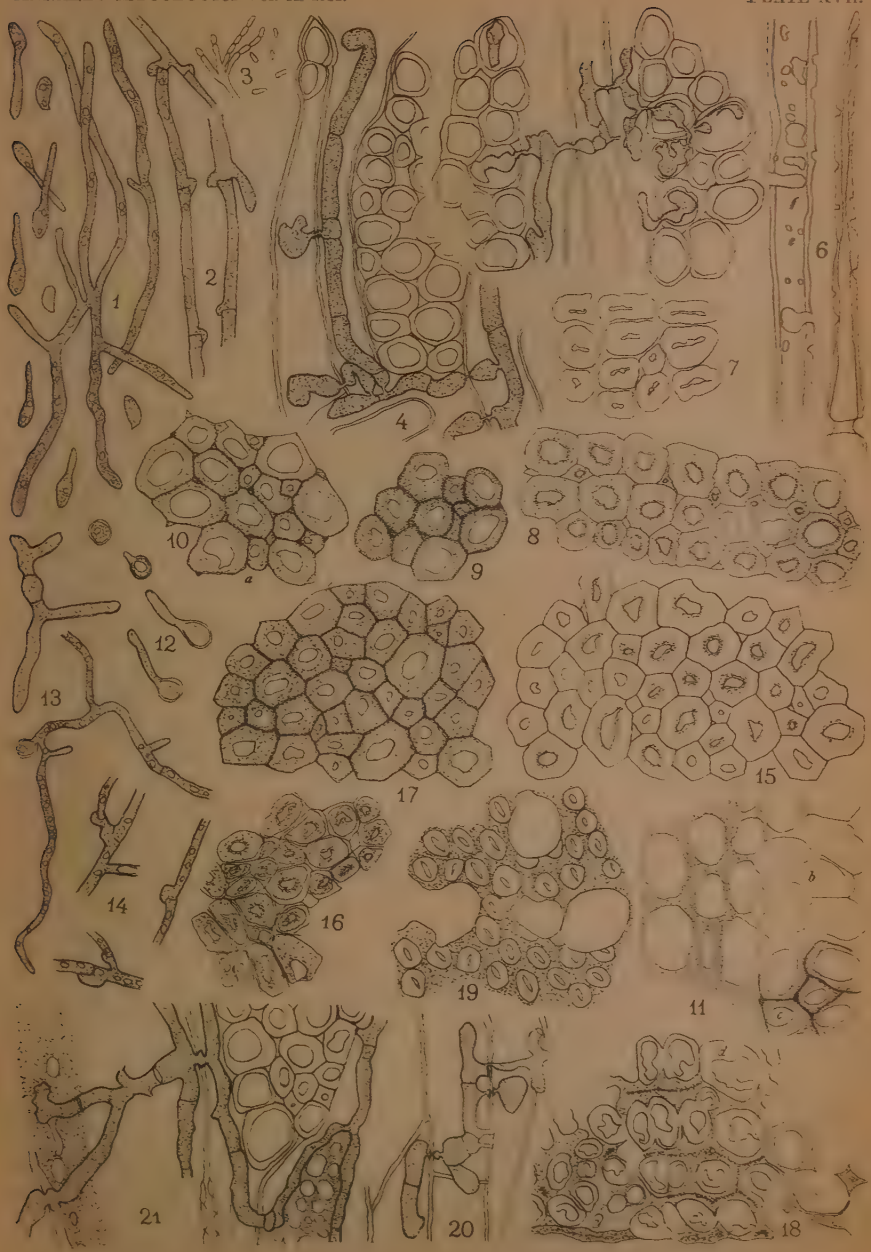

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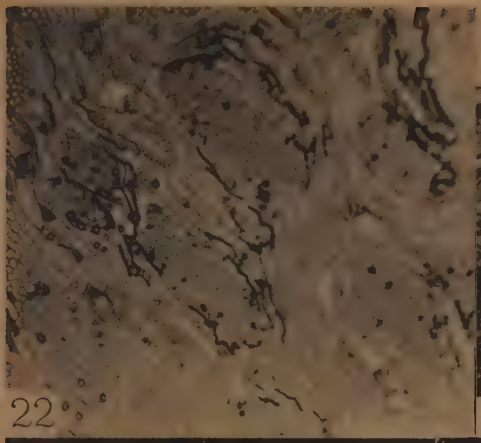

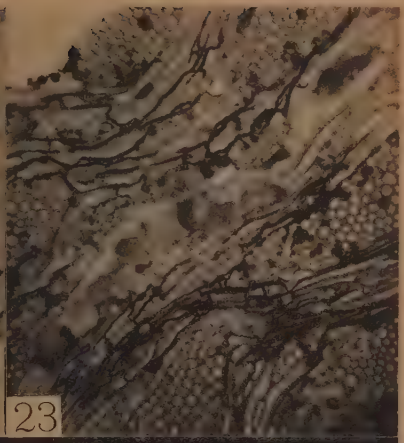

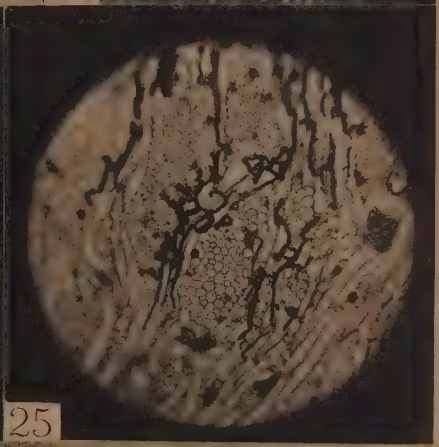

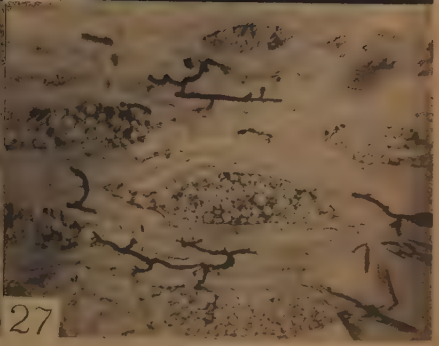

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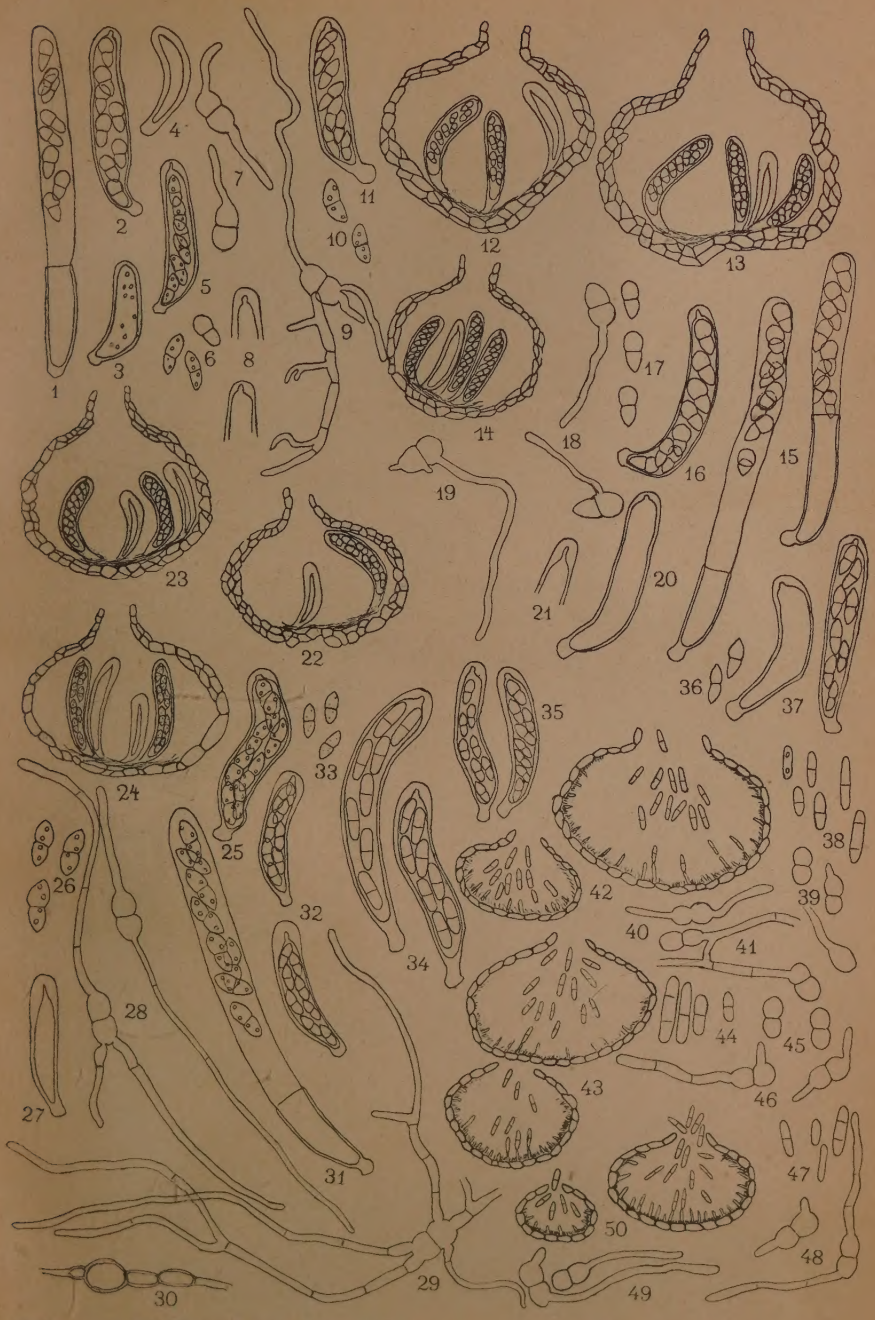

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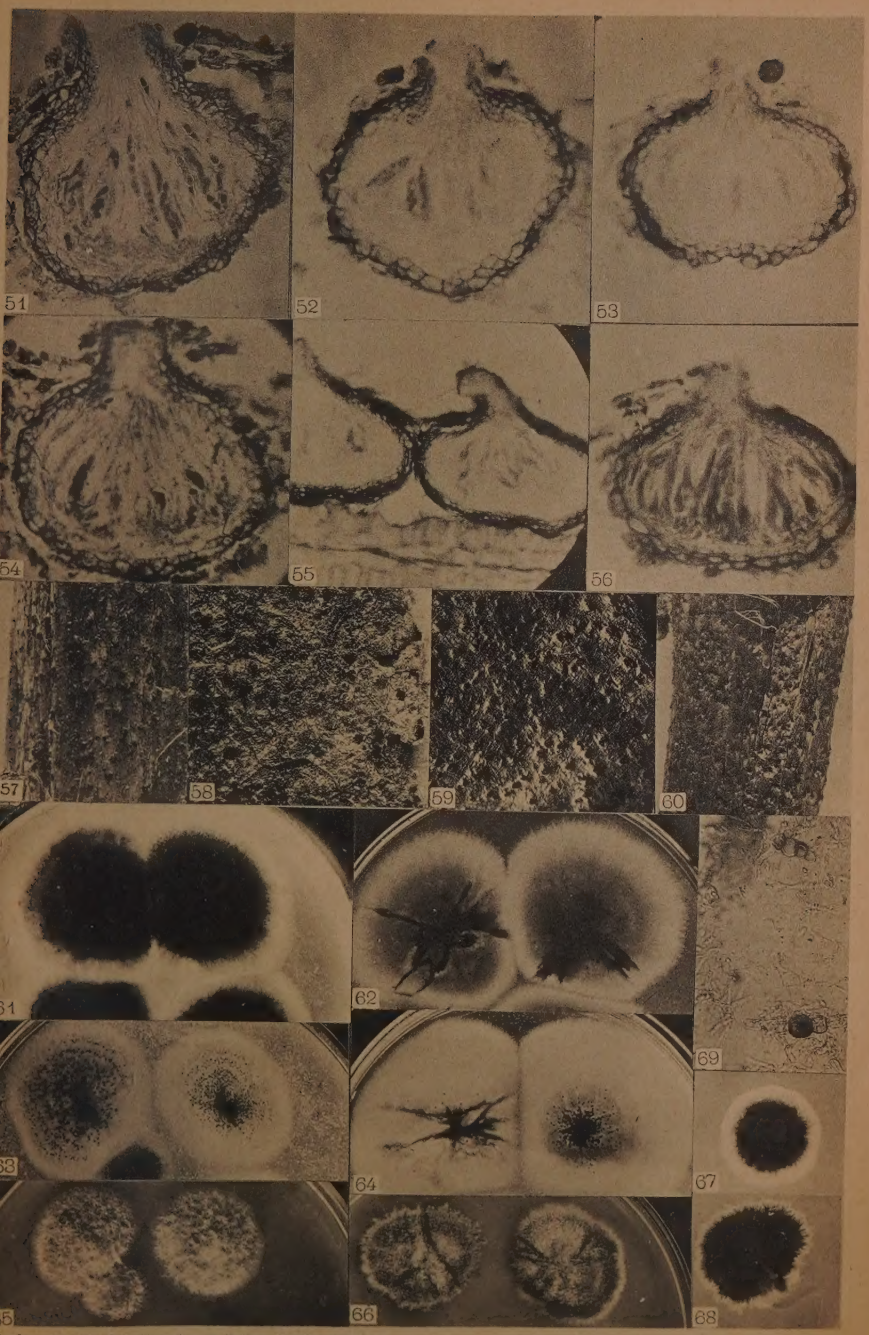

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